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Fourteen-Foot Boring and Turning Mill.

The accompanying illustration represents a vertical boring and turning mill recently built for the Harlan & Hollingsworth Company, of Wilmington, Del. It swings 14 feet in diameter, and takes in 10 feet high under the tool holders. The cone pulleys have five speeds for a 4-inch belt, which, with the geared head and changeable gears below, give sixty changes on the face plate.

The face plate is 8½ feet in diameter, arranged with radial slots for holding work. The spindle is carried on a cast steel step, and in case of turning heavy work is so arranged that the face plate can be lowered on an annular bearing to relieve the step, and at the same time assist in steadying the work.

The crosshead is raised and lowered by power, and carries two saddles with vertical spindles, one of which will move to the center for such work as boring, and the other will approach as near the center as is ever required on any class of work on which two tools can be used advantageously.

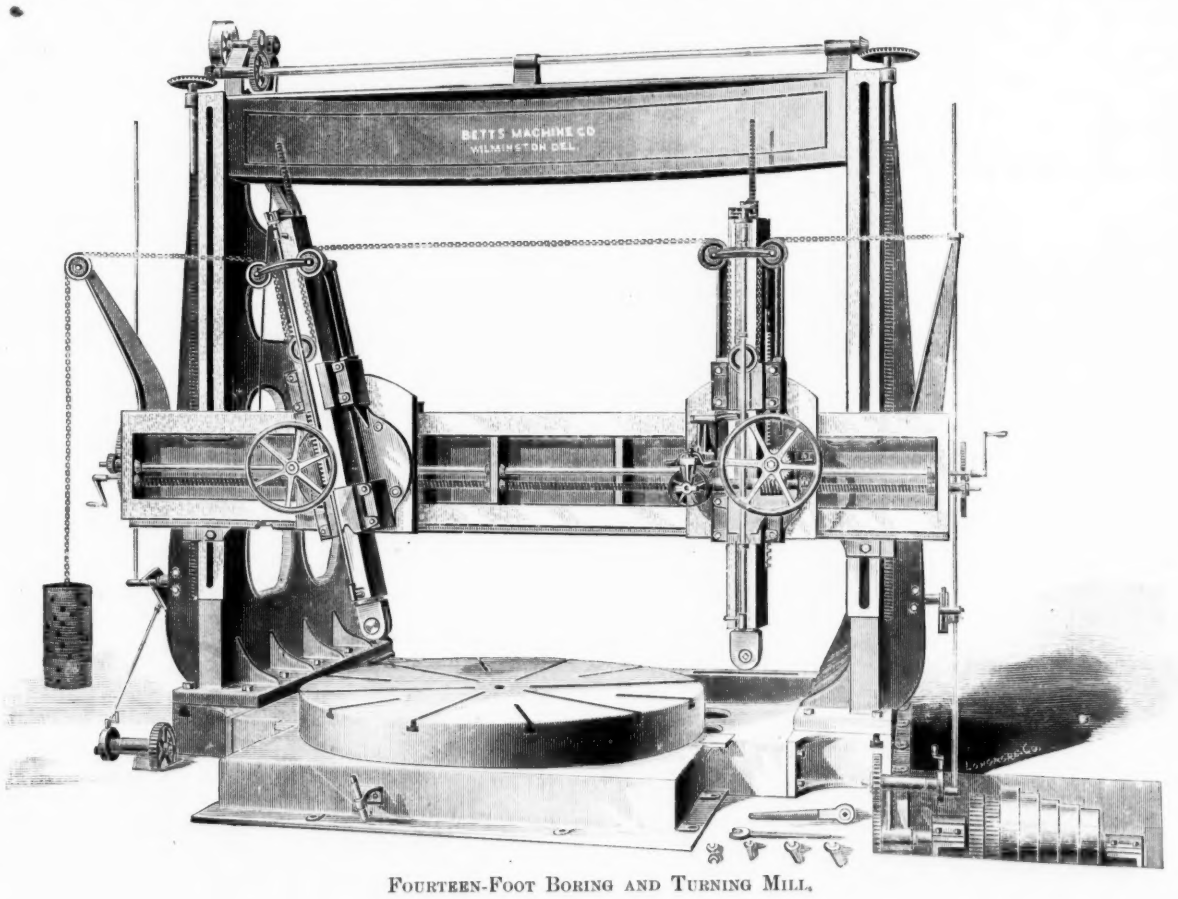
The spindles have 52 inches movement, quick hand return, and are counterbalanced. The feeds are positive, and vertical, horizontal, and angular, and are entirely independent one of the other in all their movements. Each saddle has its own feed motion, enabling one to be used with fine and the other with coarse feed at the same time.

This mill has been commended for its sterling qualities as a machine tool with reference to its general utility. It is powerful, heavy in all its parts, and has large shafts. The driving gears are cut from solid metal, and are of such proportions as are necessary for the heaviest class of work. The ratio of gearing is 232 to 1.

The total weight of the machine is over 110,000 pounds. It requires a floor space 24 feet by 16 feet, and a height above the floor of 20 feet.

To one of the heads is attached a fixture for slotting key-seats either in straight or taper holes, which is often advantageous when the work is too large to get to an ordinary slotter, and inconvenient to handle elsewhere.

The builders of this tool are The Betts Machine Company, Wilmington, Del.



FOURTEEN-FOOT BORING AND TURNING MILL.

In conversation, many Englishmen have a strong tendency to fall into slang, but their illegitimate English sometimes is very expressive. For instance, men who have endured the ordeal of riding on certain locomotives belonging to the Great Eastern Railway, call them "bone-shakers." We can easily imagine what riding on such engines means, without reading a descriptive article.

The Safety Element.

BY JAMES W. SEE.

The function of the safety element is to bring about a condition of safety by preventing the rise of danger as a cause, or of preventing damage as an effect of danger. The efficiency of the safety element is too often taken for granted.

The safety element may act by supplying a strength which the emergent strain will not overcome. Examples of such safety elements are found in bridges and other sustaining structures. In other cases they act, or are supposed to act, by preventing the emergent strain exceeding the resisting strength, as exemplified in the safety valve. In other cases they act by supplying a substitutive support when the primary support, for any reason, fails, as illustrated in the safety catches for elevators, and in the second rope, somewhat slack, used in general hoisting operations. Other safety elements act by interposing an obstacle betwixt the guarded object and the danger, as armor plating, and also in the interposition of the street gate while a train is passing, or of a railway gate while a drawbridge is open. Others, and by far the larger class of safety elements, are mere alarms of danger, and are intended to merely indicate the necessity for the exercise of real safe-guards. Taking safety valves as they run, it is a question with engineers whether they are much more than a mere high pressure alarm.

Elemental books on mechanism picture a safety valve as an elegant contrivance which is loaded to resist a certain safe pressure, but which will become opened when that pressure is exceeded, the excessive steam blowing off until the boiler pressure again reaches the safety point when the valve properly closes. Experience with the common run of safety valves leads one to think that when the safety valve begins to blow it is time to shut dampers and drafts and cease firing, under which circumstance the safety valve is treated merely as a danger alarm.

The bridge, or other supporting structure, has its strength carefully calculated so as to exactly meet the maximum strains to which it will reasonably be subjected. When this is done all of the strengths are increased say five or six times. This is supposed to give us a degree of safety represented by the factor of multiplication employed. The factor of safety thus applied has a certain value to-day, a lesser one to-morrow, and ultimately no value whatever. This is due to the wear and tear and decay of material, and the real safety must be brought about by a constant human exercise of maintenance.

The interposition of the street gate alongside the passing train might be called an absolute safety element so far as pedestrians and vehicles are concerned, it being presumed, of course, that the gate is there whenever the train is. The interposed train gate at an open draw-bridge is rather dubious when considered as a safety element, as there seems small choice between running against an efficient gate and running into an open stream. Such dangers as open draw-bridges, and open switches are now ordinarily guarded by a more or less elaborate system of warning signals.

A new safety element is introduced into the signal system by a "distant signal" and a "home signal" both simultaneously exposed, it being the intention that the distant signal shall be met and give warning in time to enable the train to be properly stopped before the home signal, or point of danger, is reached. Here we have human intelligence and caution, and love of life aided by contrivance, and it might be thought that danger was fairly guarded against.

But experience has shown that familiarity with danger breeds contempt, and that the engineer passes the distant signal and goes as close as possible, and often past, the home signal, the home signal itself being placed a reasonable distance from the point of danger. But the frequent occurrence of this "running" of the distance signal has led to the introduction of a new safety element, a safety element which may be defined as a new and certain danger to be consequent upon the "running" of the distant signal. Simultaneous with the exposure of the distant signal a switch is automatically thrown at some point between the two signals. If the engineer runs the distant signal he finds himself switched into a sand-bank or something of the kind, a danger which may be said to be harmless. Possible and probable disaster ahead will not deter some engineers from running past the distant signal, but the certainty of this ignominious switching into a sand-bank has a dreaded and certain effect.

In the operations of inclined railways, largely used for passenger service in some cities, it is customary to do the uphauling by a wire rope having in its strength a large factor of safety, and to supplement this rope by another one idly working with sufficient slackness to insure that it is not under strain. The breaking of the first rope brings the secondary rope into action. This looks like a safe contrivance, but we are brought face to face with the following questions: Does not the addition of the secondary rope imply a need of it? When the primary rope breaks, is there then a secondary rope; and may there not be the same need of one? The questions are found answered by the assertion that when the primary rope breaks the secondary rope takes its place temporarily only, and that the primary rope will at once be restored. With this view of the case we must look upon the entire system as merely an alarm system, by which we are advised of the necessity of at once making all safe again, it being obvious that the one rope is not an entirely safe arrangement.

In practice, however, it is found that the breaking of the primary rope introduces a clogging element into the running of the apparatus. The clogging element must be removed before movement can proceed. Here then, lies the real safety function of the system, for when progress becomes dangerous progress becomes estopped.

In elevators and hoists we have a vast array of catching contrivances normally idle

but intended to go into action when the hoisting rope breaks. It is to be desired that these safety catches, as they are called, be not often called into action, and it is well known that mechanism unused for long periods of time is liable to be useless when called upon.

The elevator builder often deals with multiple ropes, his reasoning being something like this: Here is a rope capable of doing the work and possessing a high factor of safety. Such a rope is safe. If, now, I add a similar rope alongside of it I am doubly safe. If I add a third rope I am trebly safe, hence there is no limit to the safety of the system. The reasoning is bad in that it fails to recognize the fact that a strained rope is safe only until wear and tear and decay make it dangerously weak. We at once see that considerable cautious judgment will be required in determining, in applying the multiple rope system, whether to divide the strain between all of the ropes, or to apply it all to a single rope and hold the others in reserve.

Assume that a moving weight is raised and lowered by a rope whose safety factor is 5. We know that in course of time this rope wears out and breaks, and that this process of weakening begins to-day and ends we know not when. Hence we can see that our factor of safety of five will be reduced infinitely below zero at some future time, and for a certainty it will be reduced below five to-morrow. It might be concluded that the addition of a second rope of similar strength to take an equal portion of the strain would be simply raising the factor of safety to ten, and that we were still at the mercy of the future. Such, however, is not the case. The two ropes cannot, under any circumstances, be of precisely the same strength or of precisely equal durability. Hence one of these ropes will break before the other, and we thus see that we have introduced into the system an alarm factor, which is, to a certain extent, an element of safety in itself. There is not likely to be an alarm factor in a single rope. If one of the two ropes had a factor of safety of five, and the other rope breaks before wear and tear have reduced the factor of the first rope to zero, then we are safe for the present. The doubt of the efficiency of the system arises from the doubt as to whether the weaker rope will break soon enough. If it defer this breaking until the factor of safety of the rope on which we must depend has fallen below zero, we find that our whole safety system is merely danger under the guise of a fancied security.

The so-called safety catch of the elevator is generally arranged to act when the rope breaks, and hence it becomes the sole sustaining medium. The wisdom of relying upon safety catches will not be discussed. But is it not well to consider the desirability of having the safety catch operate before the safety factor of the rope becomes reduced to zero; before the safety catch must become the sole reliance; in short, before the rope breaks?

The ordinary safety catch may be defined as a contrivance intended to keep the car from falling down when the sustaining rope breaks. A safety catch, arranged as above outlined, may be defined as a contrivance to keep the rope from being used when too weak. Such a system is of common use in connection with elevators, and it is thought that the system is one worthy of being carried into extended use in other places. It is thought to be simply another exemplification of the sand-bank switch located at the "distant signal" on the railroad.

In elevators embodying this safety principle there are two or more ropes. Instead of hitching directly to the car they attach to an evener, a mere lever which the equal strain of the ropes maintains in a mid-position, the car being attached to the lever fulcrum-point. The safety catch is simply a contrivance adapted to lock the car. The safety catch is normally, of course, out of action. When one of the ropes breaks the car is being pulled up by one end of the lever, and might, in this manner, be continued in operation so long as the unbroken rope would hold, but the parts are so arranged that the tilting of the lever, consequent upon one end of the lever only being pulled, throws the safety catch into operation and locks the car. Here we have a device capable of being used, with probable safety but prevented from being used until the full factor of safety is restored. In short, when one of the two or more ropes break it must be restored. It is equivalent to a single rope having a capacity for refusing further work when one of its strands breaks, or when its factor of safety becomes reduced below a given point.

A safety valve, acting upon the same principle, would prevent fuel being put into a boiler incapable of withstanding a certain strain, and would differ largely from the safety valve merely intended to limit the amount of the strain. A safety lamp upon this principle would not burn in a combustible atmosphere. A bridge upon this principle would block its roadway after a certain reduction of its factor of safety. A railway crossing upon this principle would block one cross track when the other track was in use, and, in fact, this principle is applied in this manner to railway crossings and to railroad operations generally.

Work for a Fireless Locomotive.

The Honigmann fireless locomotive, which has been described in our columns, is to be introduced for operating the St. Gothard tunnel. It will be remembered that this boiler is surrounded by a hollow chamber, which is filled with soda, and the exhaust steam being admitted creates a chemical reaction that imparts a greater part of the original heat to the water inside the boiler. The locomotives employed in the St. Gothard tunnel will have their boilers charged from a stationary boiler with sufficient steam and hot water to make the trip. This improvement in operating the tunnel is rendered necessary through the steam and smoke of ordinary locomotives vitiating the atmosphere inside the tunnel to an alarming extent, which has drawn bitter complaints from passengers. The evil has been so great that persons with weak lungs found it dangerous to make the journey through the St. Gothard tunnel.

A very interesting paper was read before the Iron and Steel Institute by Mr. Seebohm, describing the manufacture of crucible cast steel at Sheffield. When the Bessemer process was invented there was a panic among the steel makers, for Sir Henry Bessemer seemed likely to produce at £6 per ton metal which had formerly cost £60. But although he was very successful in producing a mild steel at low prices, the threatened competition, so far from ruining the crucible cast-steel makers, conferred upon them an enormous benefit. At the present moment the net result of the Bessemer process, so far as they are concerned, has been to double the demand for the expensive article which they manufacture. It may be noted as a curious indication of the jealousy of rival manufacturers that the Sheffield people refuse to invite the Iron and Steel Institute to their town lest some of the visitors may pick up hints as to manfacture which could be utilized to the disadvantage of Sheffield.—*Pall Mall Gazette.*

Ruthenburg's Roller Mill.

Roller gangs for grinding purposes have been used for many years with very satisfactory results. For some substances and purposes the surfaces of rolls revolve at equal velocity. In this case the action is merely that of crushing. In other cases the surfaces move at different speeds, in which case the action is that of grinding as well as crushing. For substances ground in a medium, such as inks and colors in varnish or blacking in molasses, etc., the three-roller system with differential speeds to the rolls is much used.

The varied speed of the rolls is usually obtained by spur gearing from roll to roll, the center one being the driver and gearing up in speed to one and down in speed to the other roll. In the course of the grinding operation the rolls need adjustment to suit the increasing fineness of the product. Spur gearing, to run properly and smoothly, should run with matched pitch lines, and even then the jump from tooth to tooth is likely to produce ridges of unground color in the product.

To overcome these objections is the object of the constructor of the machine herewith illustrated. The worms give an absolutely smooth motion in any position of adjustment, while the hard, dense surfaces of the chilled and ground rolls abrade so little that the finest tints are said to be not discolored in the least. The differential speed is obtained by different pitched worms, and the requisite direction of motion by making the pitches right and left.

These mills are made by Marcus Ruthenburg, Cincinnati, Ohio. Modifications of them are made for grinding blacking, paste, and similar substances; also for flour reduction.

Russia is largely increasing her petroleum output, and bidding for markets formerly supplied from this country. The London *Times* in commenting upon this, notes that the Russians are selling their oil in American cans with American brands. This is not the first indirect compliment of the kind. Foreign made watches under American names were largely offered here a few years ago, but they didn't keep any better time for the name, and were withal so clumsy in imitation as to be readily detected. The effect on the watch manufacturing industry here was not perceptible.

We learn from Mr. Mitchell, superintendent of the Lehigh Valley Railroad, that locomotive 383, the new engine having the Strong valve motion, has a broken cylinder, which will prevent the engine from running till a new cylinder can be made and put on.

The Inertia Diagram.

By Ed. F. Williams.

FIFTH PAPER.

During a quarter revolution, as *a b*, Fig. 7, the direction of motion of a body revolving in a circle, is turned exactly at right angles; that is to say, its motion in any particular course is entirely destroyed every quarter revolution. The lineal distance *a f*, which the body passes while its motion in the course, *a f*, is being destroyed, is equal to the radius of the circle of rotation. If the body should move through this lineal distance only, and the motion in the direction *a f* were destroyed by a force directly opposing it during the time required for one-quarter revolution, the amount of that force per lb. of mass would be tangential velocity *V*, in feet per second ÷ by time *T*, required for one-quarter revolution in seconds or fraction of second. While the force is acting through the lineal distance *a f*, or radius, the body moves through the arc *a b*, which is 1.5706 times greater than radius. According to the law of virtual velocities the forces vary inversely as the movements. Thus the centripetal, or centrifugal force must be as much greater than that required to bring the body to rest in the time of one-quarter revolution, by opposing it directly, as 1.5706 is greater than 1.

Let V=tangential velocity in feet per second.

Let T=time required for one-quarter revolution in seconds.

Let F=force in units of force per lb. of mass.

Let F′=force in terms of weight.

Then

$$F=\frac{V\times 1.5706}{T},\quad F'=\frac{V\times 1.5706}{32.16\times T}.$$

EXAMPLE.

What is the value of F when the tangential velocity is 3.1416 feet per second, and the time of one-quarter revolution .25 second (=1 ft. stroke or diameter, and one revolution per second.)

Here

$$\frac{3.1416\times 1.5706}{.25}=19.73,$$

which is the number of force units developed centrifugally for each lb. of mass in the revolving body, =.613 of the weight of one lb. at London.

At the crank end the centrifugal forces of connecting rod are exerted in full along its center line, when the crank-pin is on center line of engine, and piston consequently at end of stroke. When the piston is at point of highest velocity, the connecting-rod being tangent to the crank circle, the centrifugal forces act at right angles to the rod, and have no influence in the direction of its length. The distribution of these forces along the line of connecting rod is as follows: In full at each end of stroke; zero at point of highest piston velocity. It is the same also, in amount, at the end of stroke, as a mean of the reciprocating inertia forces of piston taken at both ends of stroke.

If the connecting rod were of infinite length the centrifugal forces exerted along the line of centers would be identical with the forces of acceleration and retardation of piston for a given mass. The angular vibration of the connecting-rod, however, has an influence upon the piston which it has not upon the crank end of connecting rod. The curves representing reciprocating and centrifugal forces are dissimilar, mainly in that the former are unequally distant from the neutral line at the ends of stroke, while the latter are equally distant. Both curves cross the neutral line at the same point. In the diagram, Fig. 8, three curves are drawn, one (*y y′*) representing forces of piston, piston rod and cross-head, exerted on the cross-head pin, one (*n n′*) representing centrifugal forces of forward end of connecting rod, exerted upon the crank-pin in the line of connecting rod. The third (*S S′*) represents the combined forces of piston, piston-

rod, cross-head and connecting rod considered as a unit, acting along the line of connecting-rod upon the crank-pin. *S S'* are the forces developed by the entire moving mass, and the curve is constructed upon the supposition that the weight of connecting-rod = weight of piston, piston-rod, and cross-head, and that the weight of connecting-rod is evenly distributed along its length, or that the center of gravity is at center of rod from end to end. This is not uncommon practice. The entire weight of connecting-rod may be supposed to act at one point—the center of gravity—and to be influenced by centrifugal and reciprocating forces in inverse proportions to the respective distances from that point to the ends of rod. For example: if the weight center were at half the length of rod, the entire mass of rod might be supposed as acting half centrifugally and half reciprocating, and a curve representing its forces would be half way between *yy'* (back end) and *nn'* (front end). If the center of gravity were two-thirds the length of rod from the back end, then the forces for the entire rod as a unit would be $\frac{2}{3}$ centrifugal and $\frac{1}{3}$ reciprocating, and the location of its curve would be one-third the distance from curve *nn'* to *yy'*. Commonly the center of gravity is very near the center of rod. Now, if the weight center is one-half the length of rod, and the weight of rod = weight of piston cross-head and piston rod, etc., the weight of the reciprocating parts, entire, may be supposed as acting at a point one-half the distance from the center of rod to back end, or $\frac{1}{4}$ the length of rod from the back end, and the forces to be $\frac{3}{4}$ reciprocating and $\frac{1}{4}$ centrifugal, the curve (*S S'*) being at all points $\frac{1}{4}$ distant from *yy'* to *nn'* Fig. 8. (The end of rod should be understood as at center of crank-pin for front end and center of cross-head pin for back end.) This point is the *inertia center* of the engine.

Table 2, gives the forces in units per lb. of mass at *inertia center* of engine; also the corresponding forces in terms of the entire weight of reciprocating parts. To construct a curve for the entire moving mass of an engine in inertia center, when the connecting-rod = 6 cranks in length, multiply the numbers in the table by the product of the square of revolutions per second by length of stroke in feet. The new number will represent the forces at each of the 12 lines.

The proportion of the force which is being transmitted from cross-head pin to connecting-rod, or from connecting-rod to cross-head pin, which has a downward or upward effect upon the guides is in direct proportion of the sine of connecting-rod angle to radius. Table 3 gives these forces under conditions named. Fig. 9, drawn to large scale, shows the manner of their distribution.

The forces due to weight of reciprocating parts acting along the line of connecting-rod upon the main bearing are the forces *SS'*. The forces upon the main bearing in the direction of the piston's motion due to weight of reciprocating parts, are the forces *SS'* × cosine of angle of connecting-rod. The forces upon the main bearing in the line of connecting-rod (parallel with it) due to the counter weight, are the forces *nn'*, and directly opposite to *SS'*. The forces upon main bearing in the direction of piston motion due to counter weight are the forces represented by the straight line *nn'*, Fig. 8, and directly oppose the forces *SS'* × cosine of angle of connecting-rod.

The centrifugal force of any body revolving in a circle which acts in any straight line passing through the center of rotation is the cosine of the angle formed with that straight line. The foregoing rules, tables, diagrams, etc., give an easy means of determining the pressure upon any bearing of an engine, any speed and size, when the location of all the weights is known. The steam pressures upon the piston are modified by the various effects of inertia upon the several bearings as per curves and lines presented. In my next I expect to show the actual forces upon the cross-head pin, guides, crank-pin and main bearing of an engine, due to the combined forces of steam and inertia, and show causes for pounding and for smoothness of action.

TABLE II.

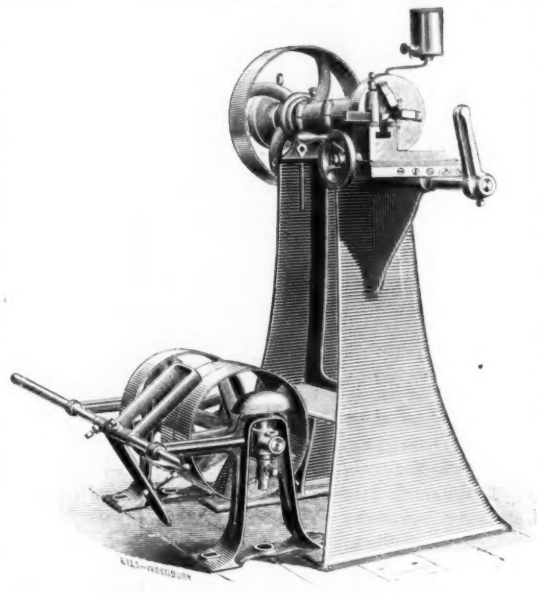
From curve S S'.

ORDINATES.	FORCE IN UNITS PER POUND OF MASS IN PISTON, PISTON ROD, CROSSHEAD, AND CONNECTING ROD.	FORCE IN TERMS OF WEIGHT OF MASS AT LONDON.
0	22.20	.689
1	19.70	.612
2	14.40	.447
3	9.00	.248
4	4.30	.133
5	.25	.007
6	4.25	.135
7	7.85	.243
8	11.30	.351
9	14.00	.434
10	16.50	.512
0	17.40	.545

TABLE III.

From curve g g'.

ORDINATES.	FORCE UPON GUIDES IN TERMS OF WHOLE FORCE TRANSMITTED.	FORCE IN UNITS UPON GUIDES PER POUND OF MASS IN PISTON, PISTON ROD, AND CROSSHEAD.	FORCE IN TERMS OF WEIGHT OF PISTON, PISTON ROD, AND CROSSHEAD.
0	.000	0.000	.0000
1	.069	1.300	.0403
2	111	1.600	.0497
3	.137	1.211	.0376
4	.156	0.7489	.0232
5	.163	0.0489	.0015
6	.166	0 705	.0219
7	.162	1.263	.0392
8	.150	1.680	.0521
9	.127	1.746	.0542
10	.078	1 228	.0381
0	.000	0.000	.0000



NEW CUTTING-OFF MACHINE.

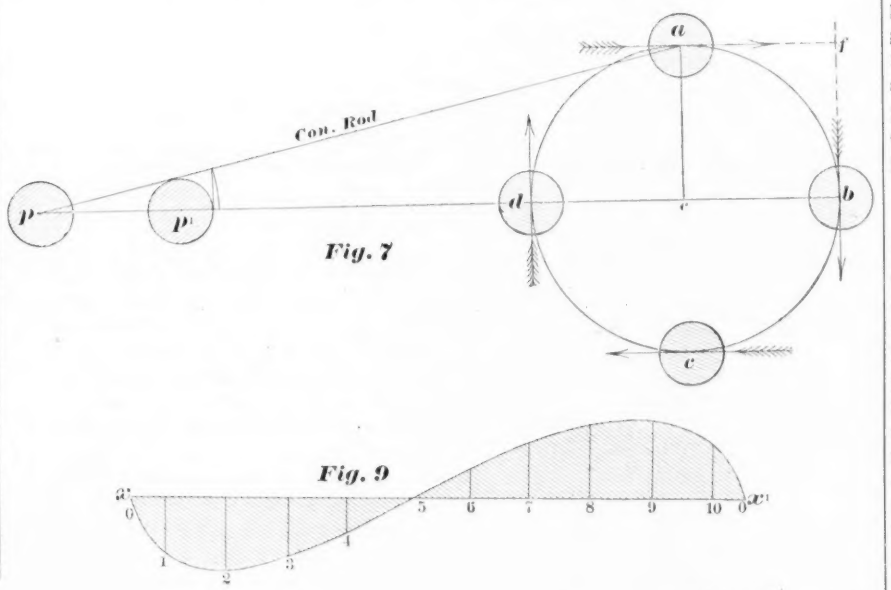


Fig. 7

Fig. 9

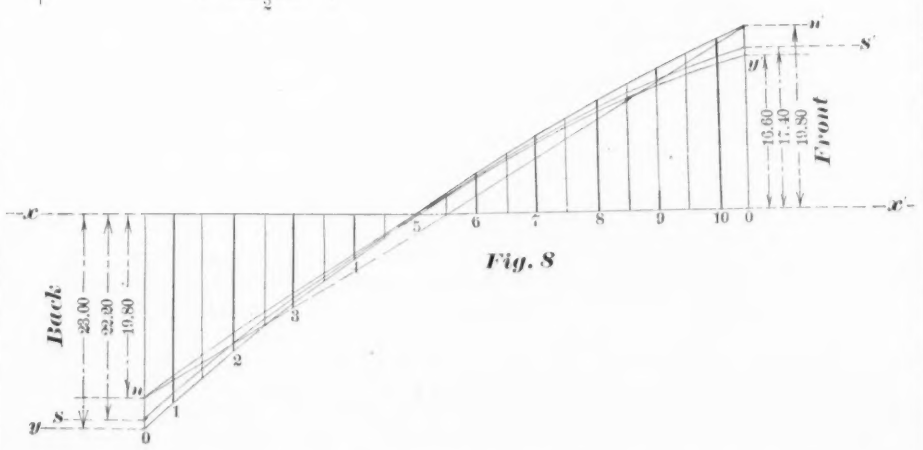


Fig. 8

formed breaking the columns and causing the floor to fall. The damage is estimated at $10,000.

New Cutting-off Machine.

This machine is a new one, manufactured by Forbes & Curtis, Bridgeport, Conn. It will cut round iron, steel, pipe, etc., up to 1½ inch rough stock. As will be seen from the engraving, which so clearly represents the tool as to render detailed description unnecessary, it is compact, occupying but little space, the intention of the manufacturers being to provide a tool of this class that should be adapted for small as well as large shops. Although of simple construction, it is thoroughly made of the best material.

Locomotive Engine Running.

BY ANGUS SINCLAIR.

From the Advance Sheets of a Book now in Press, by John Wiley & Sons.

ACCIDENTS TO THE VALVE MOTION.

RUNNING WORN-OUT ENGINES.

Some of our most successful engineers—the men who pull our most important trains daily on time—attribute their good fortune in avoiding delays to training the they received in youth, while running or firing worn-out engines that could only be kept going by constant attention and labor. In such cases, men must resort to innumerable makeshifts to get over the road; they have frequently to dissect the machinery to remedy defects; they learn in the impressive school of experience how a broken-down engine can best be taken home, and how breaking down can best be prevented. Firemen and young engineers generally feel aggrieved at being assigned to run on worn-out engines—the scrap heaps, as they are called; but the man who has not passed through this ordeal has missed a Golconda of experience—his potentialities are petrified without reaching action.

CARE AND ENERGY DEFY DEFEAT.

Among a certain class of seafaring men, the captain of a ship who fails from any cause to bring his vessel safely into port is regarded as disgraced; and, therefore, a true sailor will use superhuman efforts to prevent his ship from becoming derelict, often preferring to follow it to the bottom rather than abandon his trust. In many instances, the sentiments and traditions of seamen teach railroad men valuable lessons. The sacrifice of life is not desired or expected of engineers in their care of the vessel they command; but every engineer worthy of the name will spare no personal exertion, will shrink from no hardship, that will be necessary to prevent his charge from becoming derelict. Once I heard a hoary engineer, who had become gray on the footboard, make the proud boast, "My engine never was towed in." His calm words conveyed an eloquent sermon on care and perseverance. He had been in many hard straits, he had been in collisions, he had been ditched with engines, but had always managed to get them home without assistance.

WATCHING THE EXHAUST.

What the beating pulse is as an aid to the physician in diagnosing diseases, the sound of the exhaust is to the engineer as a means of enabling him to distinguish between perfective and defective working of the locomotive. The ability to detect a slight derangement by the sound of the exhaust can only be acquired by practice in watching those steam notes, day after day, as they play their tune of labor through the smoke-stack. When the steam ports are even, and the valves correctly set, with tight piston packing, and valves free from leaks, the notes of the exhaust will sound forth in regular succession in sharp, ringing, clear tones, every puff seeming to cut the steam clean off at the top of the stack. There is a long array of defects represented in the journey, from this case of apparently perfect steam performance, to that where the exhaust steam escapes as an unbroken roar mixed with uncertain, wheezy coughs.

The *Mechanical World* gives an account of the "running away" of the compound engines at a mill in Oldham. The engines had recently been changed from plain condensing to compound, with automatic cut-off. By some means the cut-off valve became inoperative, leaving the engines to run at full steam. Although the engineer is believed to have got to the stop valve in about forty seconds, the engines attained such a speed as to throw one of the line shafts in an upper story out of a bearing, bending the shaft in opposite directions, the two *cranks* thus

THE ATTENTIVE EAR DETECTS DETERIORATION OF VALVES.

The deterioration of piston packing, and the rounding of valve seats, which produce an asthmatic exhaust, may be followed in their downward course, if the engineer gets into the habit of listening to the exhaust and marking its changes. It is very important that he should do so. The man whose ear from long practice has become sensitive to a false tone of the exhaust, needs not to make experiments by applying steam to the engine while it stands in various positions, in order to find out where a blow comes from—whether it is in the pistons or in the valves.

LOCATING THE FOUR EXHAUST SOUNDS.

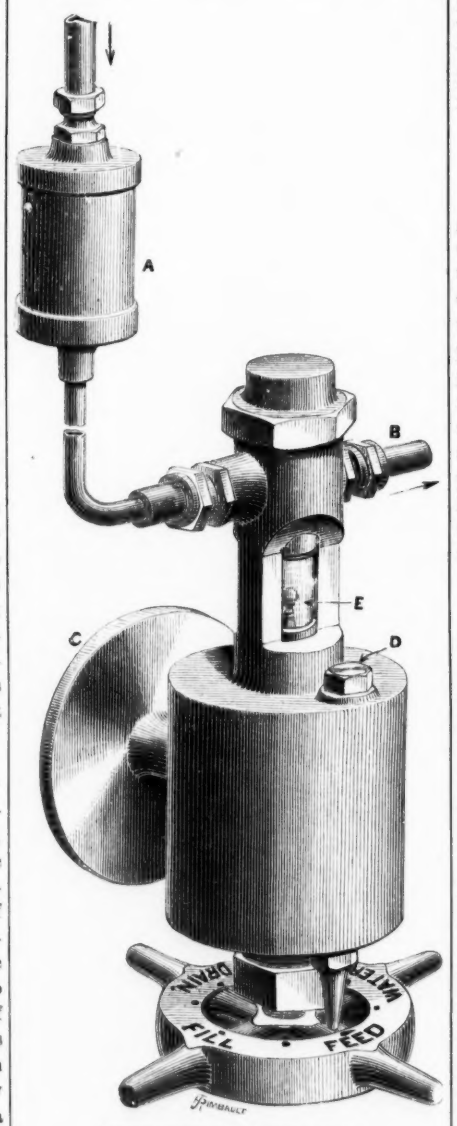
Leaning out of the cab window, he watches the crank as it revolves, and compares the noise made by the blowing steam with the crank position. When pulling on a heavy grade is an excellent time for noting imperfections in the working of valves and pistons, for the movements are comparatively slow, while the pressure of steam on the working parts is so heavy that any leak sounds prominently forth. The observing engineer perceives that the four sounds of the exhaust, due to each revolution of the drivers, occur a few inches before the crank reaches, first, the forward center; second, the bottom quarter; third, the back center; fourth, the top quarter. The first and third position exhausts emit the steam from the forward and back strokes of the right-hand piston; the second and fourth exhausts are due to discharges of the steam that has been propelling the left-hand piston. With these facts impressed upon his mind, he will understand that if an intermittent blow occurs during the period when the crank is traveling from the forward center to the bottom quarter, or from the back center to the top quarter, the chances will be that the right-hand piston needs to be examined; for the greatest pressure of steam follows the piston just after the beginning of each stroke, and that is the time a blow will assert itself. Should the blow occur while the right-hand crank is moving from the bottom quarter to the back center, or from the top quarter to the forward center, it will indicate that the left-hand piston is at fault; for at these periods the left cylinder is receiving its greatest pressure of steam.

IDENTIFYING DEFECTS BY SOUND OF THE STEAM.

It is generally understood that an intermittent or recurring blow belongs to the pistons, and that a constant blow comes from the valves. But sometimes the valves blow intermittently, being tight at certain points of the travel and leaky at other points. To distinguish between the character of these blows is sometimes a little difficult except to the thoroughly practiced ear. The sound of the blow can be heard best when the door is open, and the novice should not fail to listen for it under that condition. The valve blow is a sort of wheeze, with the suggestion of a whistle in it; the piston makes a clean, honest blow, which would break into a distinct roar if enough steam could get through. But a whistling sound in the exhaust is, by no means, a certain indication of the valves blowing through, for sometimes the nozzles get clogged up with a gummy substance from the lubricating oils, and a distinct whistling exhaust results therefrom. With a watchful ear, the progress of degeneration in the valves can be noted day after day, for it is a decay which goes on by degrees—the inevitable slow destruction that friction inflicts upon rubbing surfaces. Pistons are more erratic in their calls for attention. With them it is quite common for a stalwart blow to start out without any warning, the cause generally being broken packing rings. The various kinds of steam packing seem more liable to have broken rings than the old-fashioned spring packing, but they generally run longer with less attention.

ACCIDENTS PREVENTED BY ATTENDING TO THE NOTE OF WARNING FROM THE EXHAUST.

The habit of closely watching the exhaust is likely to prove serviceable in more ways than in keeping the engineer posted on the condition of the steam distribution gear. Its sound often acts as a danger alarm, which should never go unheeded. Many an engine has gone home on one side, and not a few have been towed in cold, through accidents to the valve gear, which could have been prevented had the engineer attended to the warning voice of a false exhaust. The nuts work off an eccentric strap bolt, and it drops out, letting the strap open far enough to cause an uneven valve-travel. If the engineer hears this, and stops immediately to examine the machinery, he is likely to detect the defect before the strap breaks. Again, one side of a valve yoke may have snapped, leaving the other side to bear the load; or bolts belonging to different parts of the links or eccentric-straps may be working out, so that the uniformity of the valve-travel is affected; and the same result may be produced by the eccentrics getting loose. Young engineers, to whom these pages are addressed, should make up their minds that an engine never exhausts an irregular note without something being the matter, which does not



SCHONHEYDER'S LUBRICATOR.

admit of running to a station before being examined. It may only be an eccentric slipped a little way, a mishap that is not calculated to result disastrously; but, on the other hand, it is probably something of a more dangerous character.

NEGLECTING A WARNING.

Engineer Joy of the D. & E. road went in with a broken eccentric-strap. Questioning him about the accident brought out the fact, that, in starting from a station, he heard the engine make two or three curious exhausts; but he was running on a time-order, and did not wish to cause delay by stopping to examine the engine. But he had not gone half a mile when he found it necessary to stop and disconnect the engine, and by doing so held an express train forty minutes.

HOW AN ECCENTRIC-STRAP PUNCHED A HOLE IN A FIRE-BOX.

A representative case of neglecting a plain warning happened on an Illinois road some time ago. John Thomas was pulling a freight train up a grade, when to use his own words, "The engine began to exhaust in the funniest way you ever heard. She would get on to three legs for an engine length or so, then she would work as square and true as she ever did, but only for a few turns, when she got to limping again." This runner knew that something was wrong, and he determined to examine the engine at the next stopping-point. But delays in such a case are full of peril. When he got over the grade, and shut off steam, there was a tumultuous rattling of the reverse-lever, succeeded by a fearful pounding about the machinery; a tearing up of road-bed sent a shower of sand and gravel over the train; then a scream from escaping steam and water drowned all other noises, and the engine was enveloped in a cloud of blinding vapor. The forward bolt of one of the eccentric-strap rods had worked out, and allowed the end of the rod to drop on to the track. Then it doubled up, and tore away the whole side of the motion; and part of a broken eccentric-strap knocked a hole in the fire-box. Here was the progress towards destruction. A small pin got lost, which permitted the nut of an important bolt to unscrew itself; then this bolt, with many a warning jar and jerk, escaped from its place in the link; and the conditions for a first-class break-down had come round.

INTEREST IN THE VALVE MOTION AMONG ENGINEERS.

Whenever locomotive engineers do congregate in the round-house, in the lodge or division room, a fruitful theme of conversation and discussion is the valve motion. Curious opinions are often heard expressed upon this complex subject. There are comparatively few men who understand it properly; but it has a fascination which attracts all alike, the wise and the ignorant; and the man who is altogether uncertain about the true meaning of lap and lead, expansion and compression, is generally more loquacious on valve motion than the engineer who has made the subject an industrious study.

TROUBLE WITH THE VALVE MOTION.

However well each may understand his business, in one respect all engineers are in perfect harmony; that is, in hating to encounter trouble with the valve-gear on the road. The valves being the lungs of the machine, any injury or defect to their connections strikes at a vital organ. With a good valve motion, and valves properly set, the steam is distributed so that nearly an equal amount is admitted through each part in regular rotation; the release taking place in even succession. This makes the exhaust notes uniform in pitch and period. A sudden departure from this uniformity indicates that something is wrong with the valve motion. It should be the signal to stop, and institute a searching examination. In doing so, avoid jumping at conclusions regarding the cause of the irregularity, and coolly examine, separately, each part whose motion influences the valve-travel.

A WRONG CONCLUSION.

Fred Bemis missed his luck by jumping too readily at conclusions. Something happened to his engine; and he stopped by compulsion, and found she would not move either way. He felt certain that both eccentrics on one side had slipped; and, considering himself equal to setting any number of eccentrics, he got down, and fixed them in what he supposed was the proper position. But, on trying to move the engine, he found she still refused to go. He kept working at those eccentrics without result till his water got low, and he was compelled to dump the fire; the consequence being, that the engine went cold, and was towed home. When an examination was made, it was found that a broken valve yoke was the cause of the trouble.

LOCATING DEFECTS OF THE VALVE MOTION.

When any thing goes wrong with the valve-motion, the first point of investigation is, to find out which side is at fault. This can be ascertained by opening the cylinder-cocks, and giving the engine steam. With the reverse-lever in forward motion, the forward cylinder-cocks should show steam when the crank-pins are traveling below the axle, and the back cocks should blow when the pins make their similar revolution above the axle. Any departure from this method of steam distribution will make one side work against the other. When the engineer has satisfied himself on which side the defect lies, he will do well to thoroughly examine the eccentrics with their straps and rods, the links with their hangers and saddles, the rocker box and arms with all the bolts and pins connecting these articles. What might be regarded as a trifling defect, sometimes makes an engine lame. I have known a loose valve-stem key put an engine badly out of square. Eccentric-rods slipping, often produces this effect. When the eccentrics are found in the proper position, the rocket-box secure in the shaft, and all the bolts, pins, and keys in good order, and in their proper positions, the fault may be looked for in the steam-chest.

POSITION OF ECCENTRICS.

With engines where keys are not used to secure the eccentrics to the shaft, their slipping on the road is a common occurrence. Eccentric-strap oil-passages getting stopped up, or neglect in not oiling these straps or the valves, puts an unnecessary tension on the eccentrics, which often results in their slipping on the shaft. Engineers ought to mark the proper position for eccentrics on the shaft, so that, when slipping happens, they can be adjusted without the delay that often occurs in calculating the right position. When the crank-pin is on the forward center, the body of the go-ahead eccentric is above the axle, and the body of the back-up eccentric is below the axle, each of the eccentrics being advanced about $\frac{1}{16}$ of the revolution from the right angle position towards the crank-pin; or, to state it more accurately, the center of the eccentric is advanced a horizontal distance to equal the lap and lead of the valve. If the valve had neither lap nor lead, the eccentrics would stand exactly at right angles to the crank. As it is, both of them have a tendency to hug the crank; the eccentric which regulates the distribution of steam following the crank. Every engineer should familiarize himself with the correct position of eccentrics, so that, when trouble happens with the valve-gear on the road, he will experience no difficulty in grappling with the mishap.

Schönheyder's Lubricator.

In this lubricator, illustrated herewith, the operations of filling, draining, regulation of feed, replenishing the water supply, etc., are controlled by the operation of a single hand-wheel through a part only of one revolution. The lubricator is connected with the steam pipe at the inlet branch *A* and at the delivery branch *B*. At the inlet side a condensing vessel, *A*, is used to provide a head of water, the oil being subjected to the pressure of steam, and to a head of water in order to project it into the steam pipe or steam chest with sufficient force. The water pressure forces the oil upward and through the glass at *E*, where the rate of feed is seen by the ascending drops. From here it enters the pipe *B*, on its way to the valves and cylinder.

It will be noticed that on the hand-wheel, at the bottom, are the words "Feed," "Drain," "Fill," and "Water." Suppose the pointer to be turned to the word "Feed." In this condition water enters from the condenser *A*, through the left-hand branch, and descending through an internal passage will displace the oil, forcing it to its destination. By a slight motion of the hand-wheel the rate at which the oil is fed may be exactly regulated.

When the oil is exhausted, which is known by the drops not ascending through the glass at *E*, the hand-wheel is turned so that the pointer stands at the word "Drain," when, by loosening a small screw-plug, the water runs off. The wheel is then turned to "Fill," which closes all the ports. The cup is then filled and set to work as previously described.

If for any cause the water in the glass should require replenishing, the pointer is

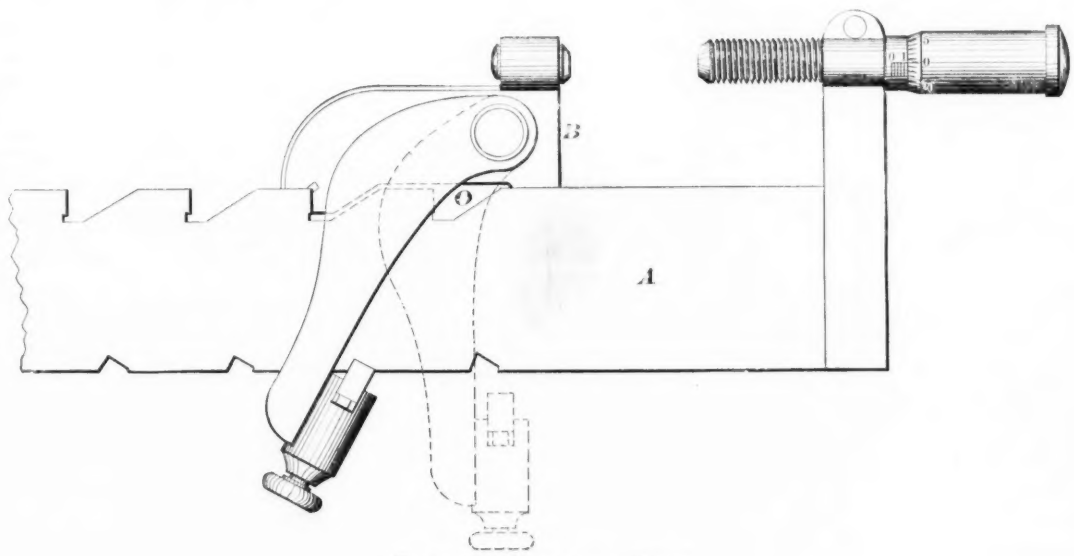
brought to the word "Water," which connects internal ports so that water will flow up and fill the glass. It will thus be seen that for the working of this cup the motion of only one tap is required, and that the necessary motions are clearly indicated.

These cups are being introduced by Lewis Olrick & Co., 27 Leadenhall street, London, E. C., England.

Richards' Micrometer Gauge.

This instrument applies the principle of the familiar micrometer caliper to the measurement with equal facility and accuracy of the larger dimensions occurring in the mechanical trades, affording a cheap and reliable standard of measurement, which would enable parties, however remote, to reproduce any stated measure. Such an instrument should be serviceable, not merely in giving standard measures, but in making the minute differences that the varieties of work demand. With the best system of solid gauges, there is still much left to be done by guesswork in the matter of difference between tight and loose fits. In making shrink fits, some mechanics use a bit of paper, or, for larger diameters, two or three thicknesses, which is about as fine work as using a pine stick to tell by the charring of it when your babbitt is hot enough, regardless of the range of melting points in compositions of that name. Measuring machines are costly, and the small establishments cannot afford them. They require care and skill in handling, and often lie unused where a cheap and handy device like the present would be in constant service.

The micrometer screw permanently mounted at the end of the beam *A* reads to thousandths, and travels one inch in length. The first inch, or fractions of it, is measured with the projecting lug of the movable block *B* in the notch marked *O*. To measure larger dimensions, the block is unlocked by drawing the spring catch out of the notch at the under side of the beam and allowing the arm to swing down to the position shown by the dotted lines, when the block may be lifted and placed in any notch desired and again locked, each notch the block is moved back adding one inch to the measurement.



RICHARDS' MICROMETER GAUGE.

The block *B* is of the same thickness as the beam *A*, and the swinging arm, being made of a plate upon each side of it united to the spring socket below, serves to keep the block in position sidewise. The block is cut away so that there is no contact between it and the beam where covered by the swinging arm.

The inventor and patentee of this instrument is Frank H. Richards, Troy, N. Y.

LETTERS FROM PRACTICAL MEN.

A Leaky Boiler and Its Repair by the Village Blacksmith.

Editor American Machinist:

I was requested to put an inspirator on a boiler that was troublesome to keep supplied with water by the force pump furnished, owing to small margin of capacity of pump over requirements of boiler and consequent loss from leakage. The boiler was built and set in brick setting in the ordinary way of setting horizontal boilers. It was covered over with brick set in lime. To put on an inspirator it was only necessary to remove a few bricks, and tap it for steam pipe. After attaching inspirator the boiler was found to be leaking badly, and on removing the rear part of setting, to get at flue sheet, it was found that fully one-half of the flues had burned and corroded down even with and, in some instances, partly through the sheet. Altogether the conditions were such that I felt justified in pronouncing the boiler unfit for further use. But that did not suit the owners, so they consulted the village blacksmith who said he could repair the boiler so it would be safe.

After the so-called repairs had been made, by driving in rough iron thimbles and hammering their ends close on the flue sheet, the next step was to find some one to run it, the man who had been running it declining. Such a person was found, who ran it two or three days, after putting in bran to stop the leaks and testing it to 40 lbs. cold water pressure. Upon removing the setting against the side next to wall to get at the side seam, the sheet, of steel, was found to be so badly corroded that one blow with the hammer drove the head clear through the side of the boiler. The corrosion was caused by the leaking of side seam, with edge of plate pointing up, thus holding the water on the plate along the seam. The adjoining plate that did not leak was perfectly sound. Thus ended the life of a boiler in less than three years. I presume that had a person been engaged to run that boiler, and had it blown up, it would have been the engineer's fault, and low water the cause.

I ought to add that there were no braces between heads; in fact none whatever in the boiler. J. T. SMITH.

Cylinder and Valve Lubrication.

Editor American Machinist:

In your issue of Aug. 9 is a report of a committee of the Railway Master Mechanics' Association on lubricants for valves and cylinders. This is a subject of interest to every engineer, and had they given direct answers to the eight questions they would have conferred a favor.

There is much to learn about the use of lubricants for valves and cylinders, especially about what is the best lubricant under certain conditions. For instance, some oils that give good results in the high pressure cylinder of a compound engine do not give good results in the low pressure cylinder, and it would be instructive to know just what the temperature had to do with it. Tallow answers well in some cases, but produces disastrous effects in others, in some instances eating away the metal so as to destroy the valves and cylinder.

I knew an instance in which an engine ran so badly as to frighten timid people out of the engine room. More tallow instead of diminishing the noise increased it, increasing the friction so that the valves could not be worked by hand. The engineer in charge could not discover the trouble, and was finally discharged. The engine was thoroughly examined, but nothing was found wrong. Finally the stores were examined and here the difficulty was exposed. The tallow was old and discolored, and rank with acid. Fresh, pure tallow being used the engine ran satisfactorily.

GEORGE OSBORN.

Hawaii, Sandwich Islands.

The Strong Valve Gear.

Editor American Machinist:

I notice in last week's AMERICAN MACHINIST the following in regard to certain patents on valve gear:

"George S. Strong, of Philadelphia, has patented a valve motion which has a very strong resemblance to the Joy valve gear. So far as we can see, the only difference is that the Strong motion has a fixed sector on which a block slides that controls the motion transmitted to the valve stem."

Now, in answer to the above, I would say that this slight difference in construction makes the greatest difference in the world in the practical working of the two gears—the difference between a gear that was not practical for the purpose for which I wished to use it, and which the company for whom I was designing the locomotive said they would not have, and a gear which is not only practical, but perfect both as to action and mechanical construction.

By this new departure, slight as it may seem, I had a new combination of parts which gave a useful effect, and as such I was entitled to a patent, and availed myself of the same, as any sane man would do. Further, I would say, that this combination is not covered by Joy's patent, and I propose, at a later date, to give a history of the development of this class of valve gear, and to give credit to whom it is due for the invention of all that is useful in it. It is a long story, and I shall not attempt to tell it now. I also propose to go into the matter of relative merit, and show where the practical differences are, and how it is possible to get 30 per cent. more work out of a given size of cylinder with one gear than with the other, and many other points too numerous to go into here. GEO. S. STRONG.

Hardening Brazed Dies.

Editor American Machinist:

I will state, for the information of D. W. H., that it is a common practice with me in die making to braze thin steel to iron or steel to steel, in cases where they are too thin to weld, satisfactorily together, and after finishing to shape, to harden and temper them, as they do not require so great a heat to temper as to braze. With care and attention they will come out all right. E. E. J.

Buffalo, N. Y.

Cutting Water Line Glasses to Length.

Editor American Machinist:

Having noticed one or two methods of cutting glass tubes to length in your paper, I will give you a plan which differs from any I have seen. Take hold of tube and measure the length it is to be cut to, and with a small rat-tail file make a scratch all round the inside of tube, when the tube will readily break off true at the scratch. With a small piece broken off the end of the file to make a sharp corner, the scratch is easily made. ADAM GRAHAM.

Ontario, Can.

Patterns at Pittsburgh Locomotive Works.

A new pattern house has recently been erected at the Pittsburgh Locomotive Works, and the system of handling patterns is admirably managed. The pattern house consists of a two-story building, 125x55 feet, and it is placed so that extensions can easily be added should the increase of business so require. It is divided into eight fire-proof apartments, each room being protected by iron doors. In each apartment down stairs there are eight cases containing tiers of shelves for holding the patterns, and up stairs each room contains ten of these cases. The arrangement is made to have the largest patterns below and the small ones above. Every pattern belonging to the establishment is numbered, and it has a regular place on the shelves or cases where the number is marked. As we enter room 1, we find, in passing through the aisles, that this room is devoted to the patterns marked from 1,000 and below 2,000. Room 2 contains the 2,000 and odd; room 3, the 3,000 and odd numbers, and so on through the whole department, the number of the room indicating the number of the pattern. Case 1 of each room contains the patterns marked 100 and odd; case 2, those marked 200 and odd, and so on, the case indicating the number of the patterns located there. Each case is divided into two portions, an upper and a lower portion, the division being made by a running board. The numbers of patterns below fifty are below the running board, those above that number are put above the running board. By this means the number on a pattern contains the directions as to where it will be found in the pattern house. Let us take a number, say 5,470. We know at once that a pattern with this number will be found in room 5, case 4, and it will be in a shelf above the running board. In no instance are the numbers all filled up with patterns. Some shelves have only one or two patterns on them; others are empty; so there is plenty of room to fill up with additions belonging to the same type.

A pattern book is kept in the drawing room, and when an order is issued to make a new pattern for any article, the pattern number is given, entered in that book, and directions are sent to enter the new piece in the book kept in the pattern house. On the ends of all the cases in the pattern house labels are hung, which are put in place of patterns taken out, and the label denotes where the pattern has gone. The system in practice has been found extremely convenient, and prevents the loss of much valuable time searching for patterns. Superintendent Wightman, who designed the system, holds that no articles about a machine shop require to be more closely kept to the principle of a place for everything and everything in its place than patterns, and this arrangement provides the place and permits of no excuse for misplacement. The pattern books are indexed, so that the number of any pattern wanted can readily be found. There are many pattern lofts where a modification of this system could be applied with little trouble, and it would end the chaotic condition of such places.

The annual meeting of the American Society of Mechanical Engineers occurs on Wednesday, November 5th, at 8 P. M. The place of meeting is 12 West 31st Street, New York. The first evening session will be devoted to an address by President Sweet and a social reunion. The society now numbers over 500 members, and a considerable addition of new members is expected at the annual meeting.

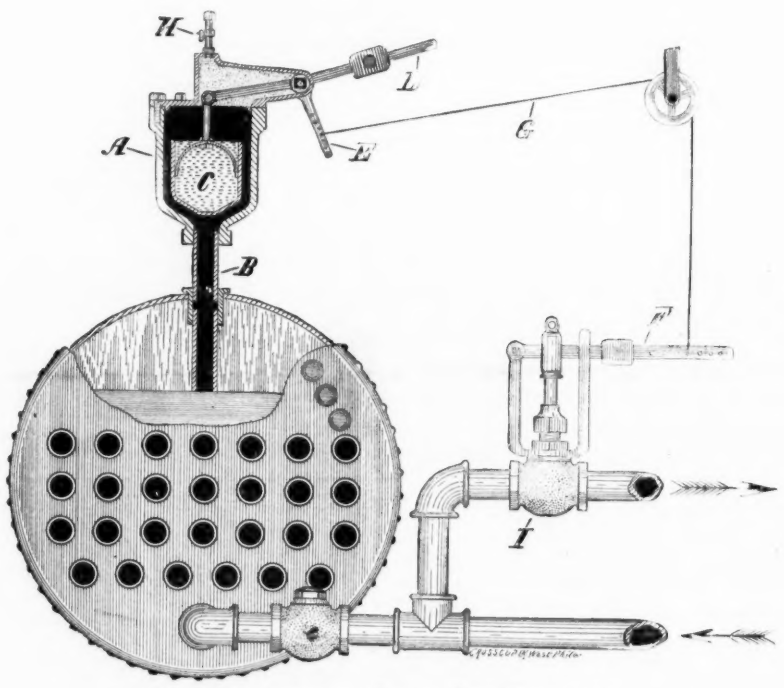
Complaints are frequently heard that foremen, particularly of dock gangs, and those engaged in similar work, demand a bonus of their men, the penalty of a refusal being their discharge. Sometimes, but very seldom, we hear this of shop foremen. This is contemptible, and we do not believe employers in any instance will sanction it. Upon a complaint coming, recently, to Com. Starin that a dock foreman of his was assessing his men he immediately ordered his discharge. We would advise that in every such instance the matter should be brought at once to the employer's notice. No workman should submit to it.

Button's Automatic Boiler Feed Regulator.

The engraving presented herewith represents this regulator, in section, connected with the feed pipes. In the engraving *A* is a cylinder composed of steam metal, which is attached to the boiler at the most convenient point by a one-inch pipe *B*, extending down into boiler to the desired water line. *C* is an iron pail attached to a brass lever, having a square hole at the other end, through which a brass journal passes, fitting tightly in lever. This journal is provided with a brass stuffing box, and extends through cylinder cap far enough to receive lever *E* and balance lever *D*. *I* is a balanced valve, opened and closed by a weighted lever *F*, controlled by a wire rope *G*, which, passing over pulley, is connected to lever *E*. This valve may be placed in the suction, and so arranged as to admit the water to the pump when needed in boiler, and to shut it off when not wanted, or it may be placed in a waste pipe leading back to the tank or suction side of pump. In either of these cases the pump must run continuously. The regulator may, however, be arranged with equal facility to operate any direct-acting steam pump, in which case the attachment is made to the throttle valve, operating to stop and start the pump, and to control the speed according to the requirements.

The operation is as follows: When the lower end of pipe *B* is submerged in the water, and air is allowed, when first starting boiler, to pass off at the automatic air valve *H*, the water, as the pressure accumulates in boiler, will rise and fill the cylinder *A*, and iron pail *C*. Being counterbalanced, the pail *C* rises with the water in cylinder *A*, and shuts off the supply to the boiler. As the water in boiler is evaporated and falls below the end of pipe *B*, the water in cylinder *A* falls back into the boiler, and the iron pail *C*, containing twelve or more pounds of water, follows down and starts on the feed. As the water again rises and covers the end of pipe *B*, and so cuts off the supply of steam to the cylinder *A*, the steam which was in cylinder *A* is at once condensed, and the water again flows up to fill the vacuum. It will thus be seen that the operation is due to gravity, no complicated machinery being required.

The manufacturer's agent for the sale of these regulators is Frank A. Hine, 80 Cortlandt Street, New York.



BUTTON'S AUTOMATIC BOILER FEED REGULATOR.

Early Engineering Reminiscences.

BY GEORGE ESCOL SELLERS.

EIGHTH PAPER.

During the entire time that Mr. Perkins was connected with these shops there was an almost daily visitor; sometimes he would come feeling his way with a cane, at others led by a boy. He would sit for hours apparently conscious of all that was going on around. Among the workmen he was known as *Old Blind Hawkins*, although under fifty years of age. His blindness, stoop and long iron-gray hair gave him the appearance of a much older man. He usually carried with him one or two small volumes, which he offered and from the sale of which he derived his main support. From these we learned all we knew of him; his name was Joseph Hawkins, born in Kingsbury, Washington County, New York, in the year 1772, and when about twenty-one years of age he sailed from Charleston, S. C., as supercargo of the *Charleston*, a Guinea trader of 400 tons burden. He sailed December 1st, 1793, and had a prosperous voyage to the coast of Africa. He was sent inland for a cargo, got a large number of slaves and much ivory and gold dust. On the homeward voyage the ship fever broke out; he took it and lost his eyesight. When or how he ever attained any mechanical knowledge, I do not know. Being a good penman, and having command of the pencil as a sketcher before he lost his eyesight, he never lost the power of using them. With his left hand to hold the paper on the table in a manner that he could use his thumb to indicate where to start the lines, with a pencil he wrote very freely, keeping his lines straight, and at all times he was ready with pencil to sketch with sufficient accuracy to aid him in explaining whatever he had to present. Besides the volume, the history of his early life, he often had with him a portfolio filled with rude drawings of his own make, from which he would illustrate his plans. No one hearing him explaining and seeing him pointing out the parts would, if they did not see his sightless eyeballs, even suspect his blindness. It was a remarkable case of the cultivation of other organs to supply the place of lost ones.

He had evidently tried, or had tried for him, many experiments with steam; his whole thoughts were on that subject. He said he had satisfied himself that the greatest economy was in using steam at very high pressure, and also the greatest safety from explosion; he even talked of using steam of 1,000 lbs. pressure to the square inch, of the great reduction in the weight of furnaces, boilers and steam engines for ocean navigation that he should make, and that by his system dangerous explosions would be an absolute impossibility, as the steam for every stroke of the engine would be generated as used. He claimed to have demonstrated that the spheroidal state of water, when thrown on heated metal, was entirely prevented by using highly-heated tubes of great strength, and maintaining in them an attenuated vapor at a pressure of not less than 175 lbs. This was done by the escape valve being loaded to that pressure. His plan was to inject into these tubes just the quantity of water required to generate the steam at the pressure wanted and required to fill the cylinder and make the stroke. He had another modification that had grown out of the difficulty of regulating the jets of water with absolute certainty. This was to keep his heavy, strong and highly-heated tube-generators full of water, and to allow just so much highly-heated water to escape and flash into steam as was required for each stroke of the engine. I do not recollect the exact mode he proposed to accomplish this.

Toward the latter part of the time father was connected with Mr. Perkins, Hawkins had succeeded in getting, by subscription, what he thought would enable him to demonstrate his theories. This subscription was headed by two retired merchants from Charleston who had settled in Philadelphia, and had known Hawkins in his early days; part was by shops in the shape of work; a brassfounder subscribed the brass castings; a coppersmith the steam pipes, etc. Hawkins was given the use of bench and tools in the P. & S. shops, and there he brought the different parts of his engine together, which he erected under a shed in a yard in the vicinity. Perkins took great interest in the work as it went on, and, no doubt, gave him much aid. On the first trial of this engine the soft solder of two wiped joints of the small copper steam pipe melted, and it blew apart in a few minutes after the engine was started. Here Hawkins' trouble commenced. For these copper pipes he substituted musket barrels, joining them by conically countersinking one and tapering the other to fit into it, drawing them together by clamps and bolts. There did not seem to be any serious trouble with his generator, but the great heat of his high-pressure steam burned out the hemp packing of his piston and piston rod. Then came a long series of experiments with metallic packing, which at the high heat, for want of lubrication, fastened to the cylinder. Then followed a most ingenious device. He put on a larger steam cylinder to work with lower pressure, a condenser to give him hot water from the escape steam; simultaneous with the flash of highly-heated steam, or water flashing into steam, hot water was injected, reducing the temperature and increasing the volume of steam at a lower pressure. He had a scheme of open and single-stroke engines, with a plan of lubricating, that I do not remember, nor do I recollect to have ever heard him allude to using high steam for rapid shooting, as was exhibited by Perkins with his steam gun in London. But he had a vision that he liked to dwell on and talk of for protecting such harbors as New York that I cannot better describe than by using his own words as near as I can recollect them. He would say that: "Ascertaining the narrowest part of the channel, I choose the position for my battery of generators, always kept heated ready to be forced to the required pressure on the approach of an enemy's fleet. Now, imagine a row of great mortars, each loaded with a shell of not less than a ton weight. I know the exact capacity of my steam engines and pumps to eject the highly-heated water; I know to a certainty its effect on flashing into steam; I also know to a fraction the quantity of water to produce the required effect; I hurl this immense shell into the air; it is no guess-work; it is all a certainty; it falls from 300 or 400 feet on to the deck of the frigate at its weakest part. What would be the effect?"

Jacob Perkins, with Col. Fairman, Mr. Spencer, and some of their workmen, went to England, expecting to contract with the Bank of England to furnish their plates; they failed in this, but in connection with Heath, of London, they furnished the plates for the Bank of Ireland and many private banks. About the time they were leaving, Mr. Hawkins expressed himself as confident that Mr. Perkins would interest parties in England, and induce them to send for him to put his system to a full and fair test. From this time I lost sight of Hawkins until after Mr. Spencer's return from England. It was supposed that he was doing well in London, and on being asked the reason of his return, he replied that he was doing well enough. But Perkins, with his steam engine and steam gun, had been so flattered that he had lost balance and imagined himself to be the inventor of the universe! He had never heard him put forth a claim to have invented his (Spencer's) scroll lathe, but almost always when explaining it to their swell visitors, it was done in a way to convey the idea that it was one of his *slight* inventions, and this so annoyed Spencer that he returned to America. About this time Hawkins came into father's office with a letter in his hand from Mr. Perkins, in which he said he had been using his best endeavors to bring *our* steam engine favorably before the public, that he had met with great difficulties not only in doing so, but in successfully working an engine he had constructed; but he hoped in the end to overcome them all. The word "*our*" greatly excited the blind man; he stamped his foot, exclaiming, "*It is mine, mine only!*" He had a London paper giving a glowing account of Perkins' new steam engine and Perkins' steam gun. If the published accounts of the first engine in London are correct, it differed but little from Hawkins' Philadelphia engine. It proved a failure. Had it been a financial success, I have no doubt but Hawkins would in that particular have had justice done him. After the first failure, Perkins labored for years on improvements, with no better practical success. Hawkins disappeared from Philadelphia, or I should most probably have again seen him. I should be pleased if this notice would bring out from some one what became of him after leaving Philadelphia. What will ever eventuate out of his ideas, elucidated as they were by Perkins, must be left to his favorite maxim, "Time proves all things."

The Hartford Steam Boiler Inspection and Insurance Company say:

"Where boilers are found to be badly corroded and pitted internally along the water-line, and covered with a heavy deposit of sediment, baked on hard, either through bad practice in blowing off boilers while the settings are still red hot, or through the action of overhead flues, the best method of preventing further mischief is to send a man inside the boiler and thoroughly scrape the shell, getting down to the sound iron. This may very likely take two or three days. Then, with a stiff wire brush, thoroughly oil or paint the corroded portion with red lead and boiled linseed oil. Two or three applications may sometimes be found necessary."

The theory of the steam engine, like every other scientific system, rests upon a foundation of facts ascertained by experiment, and of principles determined by the careful study of the laws relating to those facts, and controlling phenomena, properly classed together by that science. Like every other element entering into the composition of a scientific system, this theory has been developed subsequently to the establishment of its fundamental facts, and the history of progress in the art to which it relates shows that the art has led the science from the first. The theory of the steam engine includes all the phenomena and all the principles involved in the production of power, by means of the steam engine, from the heat-energy derived from the chemical combination of a combustible with the oxygen of the air acting as a supporter of the combustion. The complete theory therefore includes the theory of combustion; the consideration of the methods of development and transfer, and of losses of heat in the steam boiler; the examination of the methods of transfer of heat-energy from boiler to engine, and of waste of heat in this transfer, and, finally, the development of mechanical energy in the engine, and its application, beyond the engine, to the machinery of transmission, with an investigation of the nature and method of waste in this last transformation. —*Prof. Thurston, at Meeting of British Association.*

A Salt Lake City paper mentions a thrilling railroad incident, which recently happened on the Utah Central Railroad track. A child crept between the rails as a train was approaching, which was within ten rods of the infant before the engineer per-

ceived it. He immediately applied the air-brake and reversed the engine, and by this prompt action stopped the engine just as the pilot was touching the child, and it was taken out uninjured.

Duplex Double-Plunger Steam Pump.

The engraving represents a pump made by the Gordon & Maxwell Co., Hamilton, O. As will be seen, it is that type of pump in which one engine operates the valves—plain slides—of the other. The plungers are outside packed, working in both ends of the pump.

By removing the screw plug in the top of the priming chamber, the pump may be readily primed should it be necessary. All the parts are easily come at for repairs or renewal, their location being readily determined by means of the reference numbers and accompanying explanation, which are designed to make the ordering of duplicate parts a simple matter, the different pieces being made interchangeable. The numbers and explanations render a detailed description unnecessary.

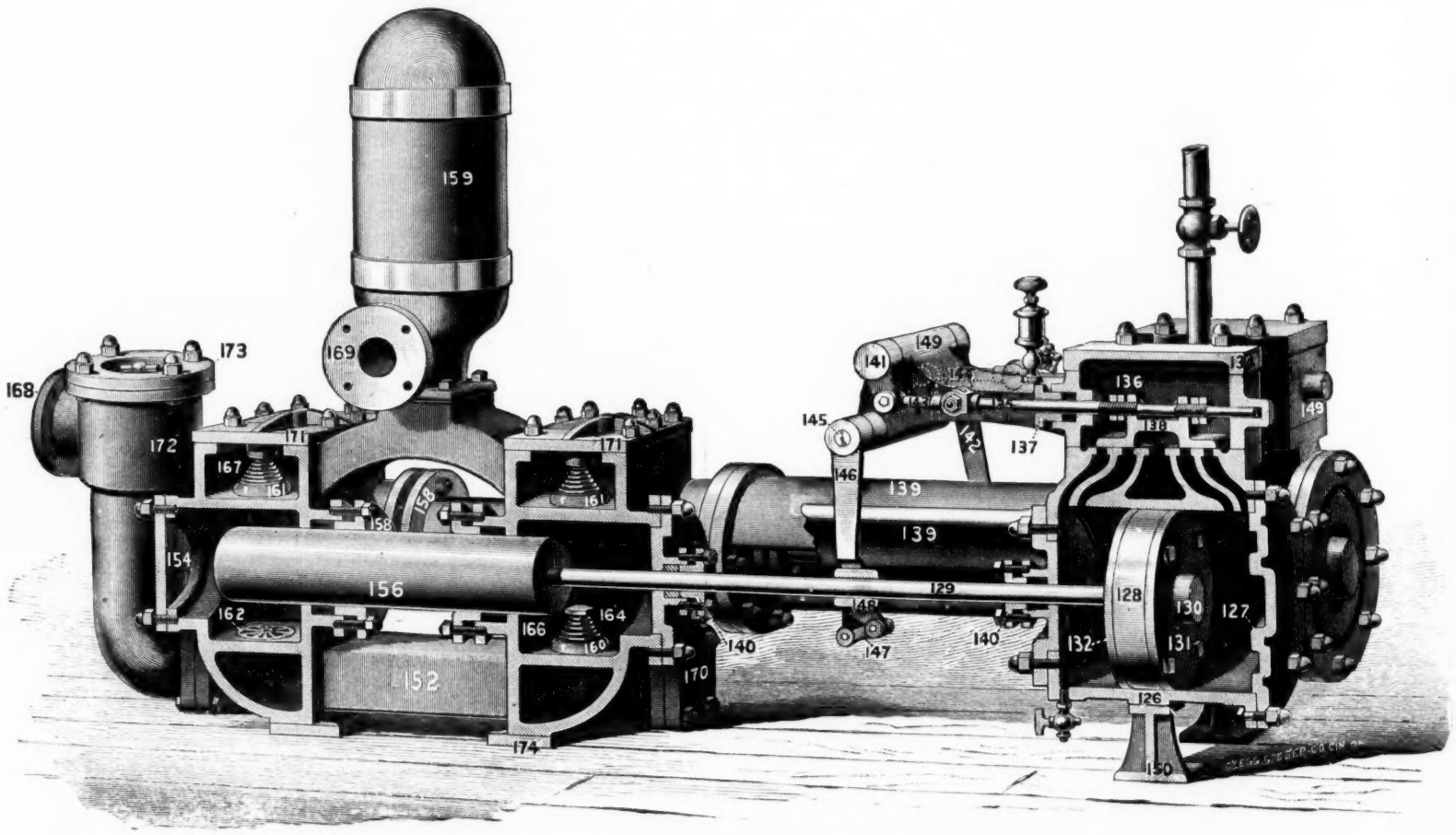
NUMBERS AND NAMES OF PARTS OF DOUBLE-PLUNGER PUMP.

152—Pump body.
154—Pump head.
156—Pump plunger.
158—Pump plunger stuffer.
159—Pump air vessel.
160—Pump suction valve.
161—Pump discharge valve.
162—Pump suction valve seat.
163—Pump discharge valve seat.
164—Pump suction valve stem.
165—Pump discharge valve stem.
166—Pump suction valve spring.
167—Pump discharge valve spring.
168—Pump suction pipe flange.
169—Pump discharge pipe flange.
170—Pump blank suction flange.
171—Pump valve chamber cover.
172—Pump priming pipe and chamber.
173—Cover for strainer chamber.
174—Support under pump.
175—*Nut for plunger rod.
176—*Flange fitting on taper of rod, for plunger.
177—*Washer under nut on plunger rod.

NUMBERS AND NAMES OF PARTS OF DUPLEX ENGINE.

126—Steam cylinder, right or left.
127—Steam cylinder head, right or left.
128—Steam piston packing ring.
129—Steam piston rod.
130—Steam piston nut.
131—Steam piston follower.
132—Steam piston.
133—*Piston spring.
134—Steam chest cap.
135—Slide valve stem.
136—Slide valve jam nuts.
137—Stuffer for valve stem.
138—Slide valve.
139—Connection between engine and pump.
140—Stuffer for piston rod.
141—Upper rock shaft.
142—Lever for upper rock shaft.
143—Short link for valve stem.
144—Long link for valve stem (shown in dotted lines).
145—Lower rock shaft.
146—Lever for lower rock shaft.
147—Link on cross-head.
148—Cross-head on piston-rod.
149—Steam chest and rock shaft support.
150—Steam cylinder leg.

* Not shown on cut.



DUPLEX DOUBLE PLUNGER STEAM PUMP.

Tests of Worm and Spur Gears.

Recent tests made by Professor Thurston of three different types of gearing, for the purpose of determining the proportion of power absorbed by friction, are interesting as throwing some light on this subject. The tests were of: 1. An ordinary worm and wheel, the worm double threaded, 2″ pitch; pitch diameter, $6\frac{1}{10}$″; length of worm, $4\frac{15}{16}$″. The wheel was $15\frac{5}{16}$″ pitch diameter, $2\frac{1}{2}$″ face; velocity ratio, 25 to 1; worm of bronze, wheel of cast iron. 2. An Albro-Hindley worm and wheel, worm, $6\frac{7}{8}$″; pitch diameter, 5″ long; velocity ratio, 25 to 1; worm and wheel cast iron. 3. Two pairs of spur wheels and pinions, the wheels having 80 teeth, 4 pitch, and the pinion 16 teeth, giving a final velocity ratio of 25 to 1.

The ordinary worm was driven at speeds varying from 41.6 to 337 revolutions per minute, giving speed of gear of 1.66 to 13.43 revolutions. The horse-power transmitted to the gearing ranged from 0.2 to 4.14, and that taken off at the brake from 0.55 to 1.77; efficiency, from 0.268 to 0.458.

The Albro-Hindley worm was tried under precisely similar circumstances, the efficiency ranging from 0.33 to 0.64. In both instances standard laboratory sperm oil was used as a lubricator.

In testing the spur gearing, the speeds of the driving pinion were from 36 to 231 revolutions, the horse-power communicated to the train from 0.18 to 2.67; power delivered, from 0.133 to 2.21; efficiency, 0.51 to 0.92.

From the tables prepared it is shown that the efficiency in the case of the ordinary worm gearing increases with the velocity up to 221 feet of rubbing per minute, from which it decreases as the speed is increased. With the Albro-Hindley worm and wheel the maximum efficiency was at 243 feet of rubbing per minute. Professor Thurston concludes that the investigation has brought out the important facts that, with either form of gearing, the highest efficiency is to be found at a speed of rubbing of the surfaces in contact, which is different with different forms and proportions of gearing; that the "Hindley screw" is a more efficient form of worm gearing than the usually considered standard worm gear, and that the best form by far, as respects efficiency of transmission, is the epicycloidal form of spur gearing of the same total velocity ratio, the loss of power in the last-named being but about one-third or one-fourth as great as in the worm gears.

Fort Pitt Machine Shops.

A walk through the Fort Pitt Foundry and Machine Shop, owned by Mackintosh, Hemphill & Co., Pittsburgh, Pa., impresses one with the rapid progress that steel castings are making in the construction of heavy machinery. To enumerate the parts of heavy steam engines that formerly were made of iron forgings, and are now made from cast steel, would be like making out an inventory of the pieces an engine is composed of. Here we saw some immense cross-heads that were turned out of the mould so clean that they required very little finish. Many castings, of difficult shape to make of any material, were lying round, made of steel, and most of them came out free from flaw or spot. Progress in this art, as in all others, is leading to perfection, and practice enables the moulders to overcome the faults that were commonly imputed to steel castings when they were first tried.

There is some extremely heavy work on the machine shop floor of this establishment. Almost completed is a double cylinder reversing engine for the Pennsylvania Steel Company. The cylinders are 28x40 inches. The steam is distributed by double slide valves, balanced and operated by a link motion. A hydraulic cylinder is provided for reversing the motion, and it acts as promptly on this huge engine as a good steam reverser operates on the P. and R. locomotives. On the center of the main shaft is a spiral gear cog, which engages with a gear wheel weighing 13,000 pounds. The engine alone weighs one hundred tons.

Another large blowing engine for the Edgar Thomson Steel Works is well advanced. The steam cylinder of this engine is 40x60 inches, and the blast cylinder has an inside diameter of 84 inches. All the heavy shafts and cranks of these engines are made from steel castings.

The tools used in doing the heavy work characteristic of the Fort Pitt shops are mostly of quite modern make, many of the machines having been specially designed for the operations they perform. There is a particularly large double-headed boring mill in the machine shop. It is capable of boring a cylinder 17 feet diameter, and of turning a pulley 34 feet diameter. The spindle, which is in a cellar below the machine, is 24 inches diameter, and the complete tool weighs 110 tons. Every movement of this large boring mill is done by steam power.

Natural gas has been applied to nearly all heating purposes about these works. All the boilers and annealing furnaces are heated in this way.

The Springfield *Republican*, in discussing poverty in Massachusetts, says:

"Some apprehension was expressed last winter, when the cotton mills began to close, or to shorten their hours of work, that poverty would greatly increase, and we should have a return of the 'hard times' which prevailed six or eight years ago. This alarm soon subsided, but many people still suppose that the times are hard, and that the poor are suffering in New England, and particularly in Massachusetts. The annual returns of the number and cost of the poor, which have reached a considerable degree of accuracy in Massachusetts, do not indicate this at all; but, on the contrary, show that poverty here has not kept pace with the growth of population during the last year."

The Denver Exposition came to a close a week before the time originally announced. It was a financial failure. The Denver *Journal of Commerce* says: "The reasons the Exposition did not pay are as numerous as they are patent. The building is too far from the city; the day rates of admission were too high, and the nights too chilly for a crowd in the evening. A great number of indemnity tickets were on the market, and fell into the hands of scalpers, who sold them for less than regular rates, thus causing a material effect on the cash door receipts."

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NEW YORK, NOVEMBER 1, 1884.

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Skilled Workmen as Foremen.

We recently heard of the foreman of a machine shop losing his position because—so the expression was—he would not wear a "white shirt." Of course, the expression was a figurative one, but it set forth in its way a complaint often heard about foremen who are thoroughly competent workmen—those who have "risen from the ranks." That is, the difficulty of keeping them from doing a good many things that others at half their pay should do. To put it another way, that they do too much they are not paid for doing, to the neglect of things much more important, in the aggregate, which they are paid for doing. Nothing is more natural than for a foreman, skilled in the use of the tools of his trade, to take hold and do the job he sees some one getting at bunglingly, and nothing more certain than that, except in very rare instances, this is just what he ought not to do. Every one who has tramped around as a machinist has seen this kind of a foreman—always ready to do the work of the awkward workman—and it is astonishing how many awkward workmen such a foreman will have. Our correspondent, who, a few months ago, represented Brown, the boiler shop foreman, working up and fitting a dome to a boiler while a half dozen of his men looked on to see how it was done, drew a clever picture of what is often seen in the shop, only the half dozen men immediately interested were probably not the only ones affected by the inattention of Brown to other matters.

We hear, more and more frequently, the opinion expressed that a man who is only in a general way acquainted with the required mechanical processes of a trade, makes a better foreman than the one who has had practical experience as a workman with every detail. We do not believe this. But it is undoubtedly true that the skilled workman filling the position of foreman is more likely to get "fussy" because his men do not handle tools just as he would, and instead of making his views known in a word here and there, tries to do so by example. This is, for evident reasons, not a fault of the foreman who cannot handle tools himself, and the lack of this fault is often equivalent to a virtue. It is not the single job that possibly might be expedited if the foreman gives all his attention to it, and does the bigger part of it himself, that is important from the proprietor's standpoint; but the fifty other things that suffer for lack of attention. There is every reason why the skilled workman should make the best foreman if he appreciates the fact that, as compared with his duties as a workman, he must *spread out* his efforts, and that saving fifty cents in a special direction, and losing ten cents in each of twenty directions, leaves the balance on the wrong side. He must curb his inclination to do a good many things that he *thinks* he can do better than he can get them done, by at least imagining that he wears a "white shirt."

A few months ago the British newspapers were publishing notes on the probable reduction of the American tariff to a revenue basis only. They tried to raise the strong hopes of English manufacturers that our markets would soon be open to their productions without paying much toll for entering. The vision was a bright one for a time. It is so no longer. The British papers are close observers of American industrial affairs, also of the sentiments of the people upon an industrial policy, and the fact that those papers have all ceased to hold out hopes of a reduced tariff is very significant. Something must have happened to cause a sudden lukewarmness in keeping the minds of the English people directed to their great object, viz: the breaking down of American manufacturing interests and the capturing of our markets for themselves. But when we turn to some American newspapers we find more ardor in the crusade against our protective tariff. Many patriotic citizens wonder where they get their inspiration from. Can it be possible they sre acting as agents of the Cobden Club?

Changing Mailing Address.

We frequently receive requests from subscribers to change the mailing address of their paper, coupled with apologies for having to request a change of address so frequently. No apology is needed. Our mailing system is the best of which we have knowledge, and such changes are simply a part of the routine work of our mailing room. The AMERICAN MACHINIST has also the great advantage of being for sale everywhere by newsdealers, at the low rate of 5 *cents a copy*, but no mail subscriber, however often he may change his residence, need fear incommoding us by request to change his address. In ordering such change always state both the old and new address.

Training the Eye.

It is undoubtedly true, as claimed, that athletic sports, properly indulged in, serve a useful purpose, but it is strange that the need of training the eye is so seldom thought of. The eye of the mechanic, for instance, is his main dependence, much of his skill depending upon his ability to see distinctly and correctly. Why, then, since the eye is of such general as well as specific utility, should not its powers be developed and trained, as well as the muscles of the arms or legs? The systematic destruction of the eye is begun at home, continued in the school-room, where little attention is paid to light and less to ventilation, and, so far as the artisan is concerned, is often later along concluded in worse-lighted and poorer-ventilated shops and factories. We hear of prizes for running, jumping, rowing, etc., but whoever heard of a prize for clear-sightedness?

Dr. Carter, in a report to the Medical Society of London, calls particular attention to this subject, giving statistics showing the great prevalence of irregularity of vision, and arguing strongly for some remedy. He would have keenness of vision made a point of excellence in athletic sports, and popularize sports in which it played an important part.

Undoubtedly, this would serve a useful purpose, but the first point which should receive attention is the school-room, and the next the workshop. Both need better light and ventilation. Civilization is responsible for the greater part of defective vision, and it ought to determine the remedy.

On our first page this week we publish an article on "The Safety Element," by James W. See, whom we presume most of our readers recognize as "Chordal." The book "Extracts from Chordal's Letters," of which two editions were published by us, has since been enlarged and republished by John Wiley & Sons, Astor Place, New York. It is published at $2.00, and is being widely sold among those interested in mechanical matters. This book treats a variety of mechanical subjects in a bright, sparkling and occasionally humorous style. It is full of useful hints about shop work, and gives a lot of character sketches (some of them illustrated), which every mechanic will recognize and enjoy.

Literary Notes.

OGILVIE'S HANDY BOOK OF USEFUL INFORMATION and Statistical Tables of Practical Value, for Mechanics, Merchants, Editors, Lawyers, Printers, Doctors, Farmers, Lumbermen, Bankers, Bookkeepers, Politicians, and all classes of workers in every department of human effort, and containing a compilation of facts for reference on various subjects, being an epitome of matters Historical, Statistical, Biographical, Political, Geographical, and of equal interest. Compiled by J. S. Ogilvie. New York; J. S. Ogilvie & Company, 31 Rose street.

This is a modest book of 128 pages, and contains information well worth the price, viz.: 50 cents. Those buying it will hardly expect to find everything in it that its title might lead them to expect, but most readers will find enough to more than satisfy them for the small investment required.

THE MAN WONDERFUL IN THE HOUSE BEAUTIful. An Allegory. Teaching the Principles of Physiology and Hygiene, and the effects of Stimulants and Narcotics. By Chilion B. Allen, A. B., M. D. New York: Fowler & Wells Company publishers, 753 Broadway.

This book is not much in our line, but our mechanical readers who wish to obtain some insight into physiology and hygiene in an attractive shape, will find the book pleasant reading. Although the pills of knowledge are coated in allegorical sugar, they are no less effectual than doses of facts presented in the ordinary nauseous style of literary baldness.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(415) S. Y. W., Reading, Pa., asks: Who is the publisher of Mr. West's book on American Foundry Practice? *A.*—John Wiley & Sons, 15, Astor Place, New York.

(416) L. J. G., Brooklyn, N. Y., asks: 1. Which is the best, hard or soft water, for hardening steel? *A.*—Soft water is preferred. 2. What is best to use to clean belts? *A.*—Warm water and soda is as good as anything we know of.

(417) A. S., Chicago, Ill., writes: I have a worm-gear pattern to make, having forty-two teeth, 1¾" pitch, to gear with a screw 5" diameter. The face of gear is to be curved. What is the proper position for pitch circle? *A.*—See answer to question 287, September 1, 1883.

(418) E M., St. Agathe, P. Q., asks: Would an engine with an eccentric that changes the motion of valve in one-quarter of a revolution be an improvement? *A.*—As we understand your question, No. If you will send us a rough sketch of your arrangement we may see it differently.

(419) W. A., ——, writes: I have a boiler 36 ft. long, 34" diameter, plates ⅜", cast-iron heads. There are three stay bolts 1½" diameter, the whole length of boiler. I expect to carry 90 lbs. steam. What will be the expansion in the length of boiler, and will the expansion of the shell and bolts be the same? *A.*—The expansion of shell and bolts is likely to be a little different, owing to difference in quality of metal and slight difference in temperature. It will be about ¾". We should prefer shorter stays from heads to shell.

(420) P. G., Altoona, Pa., asks: Can I pump water to a height of 400 feet through a pipe 1¼ inches diameter, without any other arrangement than a check valve at the pump? *A.*—Yes, with a pump strong enough to pump against that head there will be no trouble. The pump will have to work against about 200 lbs. pressure per square inch. For convenience in getting at pump valves, it may be advisable to put a check valve in the pipe near the pump, which will be better if one size larger than pipe.

(421) C. S., Cincinnati, O., asks: 1. How is the area of chimney for a tubular or flue boiler found. *A.*—The area of opening in chimney should not be less than the combined area of opening through tubes. 2. How is the pressure that a steam boiler may safely carry found, and how is a boiler tested? *A.*—The safe working pressure is best found by an inspection of a competent engineer. Boilers are tested in various ways, the most common being by cold water pressure. 3. How is the angle for cutting bevel gears found when you have a drawing? *A.*—You can readily find the angle from the drawing, or the draftsman will give it to you.

(422) M. J. B., Yarmouth, N. S., writes: What is the cause of so many hot journals to be seen on American freight and passenger cars? I was twenty-one years in the employ of an Old Country railway, eleven years of that time being engaged as guard of a fast passenger train, and I never saw a hot box there. *A.*—Our correspondent had extraordinary luck if he was eleven years guard of a fast train without seeing a hot box. From our experience of the trains in this country and in Europe, we would say that there was little difference as to the number of hot boxes. If this continent's railroads have more hot boxes than are to be seen abroad, the cause might be found in the greater proportion of sand ballast used on this side of the Atlantic.

(423) W. A., ——, writes: Will you give me a rule, without the use of formulæ, for determining the flow of water through pipes of different diameters and lengths, and under different heads? *A.*—The following formula, from Box, is for the discharge in English gallons (10 lbs.):

$$G=\left(\frac{(3d^5)\times H}{L}\right)^{\frac{1}{2}};\ G=\text{gallons,}$$

per minute, H=head of water in feet, d=diameter of pipe in inches, and L=length of pipe in yards. From this the following rule can be deduced: Mul-

tiply the fifth power of three times the diameter of the pipe in inches by the head of water in feet, and divide by the length of pipe in yards. The square root of the quotient will be the discharge in English gallons per minute. To reduce to U. S. gallons, multiply by 10 and divide by 8.33.

(424) J. S. D., Spencer, N. Y., writes: I am thinking of coring the hangers for line shaft, so as to drive in sections of wrought-iron pipe, with the hole, when smoothed out, just large enough to admit the shaft. If this method would work satisfactorily, it would be much cheaper and quicker than rebabbitting, as the sections can be kept on hand, and when old ones are worn new ones can be driven in. What do you think of the plan? *A.*—We think it will be very unsatisfactory. A soft wrought-iron box for a wrought-iron shaft would be about the worst arrangement, so far as cutting, creating friction, and inducing wear, are concerned that could be used. You could use cast-iron bushes; but then, by the arrangement you propose, it would be difficult to get the boxes in line, and more difficult to keep them so. Line-shaft boxes, properly made and put up, are not likely to cause trouble for a good many years.

(425) J. H. S., Newark, N. J., writes: I have an engine 12″x20″, running 95 revolutions per minute. It has cut-off plates on the back of main valve, operated by the governor. It has always worked well till within a few weeks, now it works with what the engineer calls a long and a short leg. I have had several machinists at work on it, but they do not help it. The last one says he cannot understand the trouble, unless it is that the cut-off plates at times leave their seat. He proposes that I remove the cut-off plates and use a throttling governor. What do you think of it? *A.*—From your description, we should be inclined to believe that the trouble was in the governor, or in its connections to the valves. Perhaps there is too much friction in the governor, or in some of the connections. You can judge if the trouble is as indicated, by watching the action of the governor. If it is jerky and moves in a direction to cut off steam when the exhaust has a "short leg," and *vice versa*, coupled with the fact that the engine has heretofore run well, it is pretty good evidence that the governor and its connections need overhauling. It is essential that the governor and its connection to the valves be as nearly frictionless as possible. Your engine will undoubtedly run all right with the throttling governor, but you will probably burn more coal.

(426) A. F. W., Providence, R. I., writes: 1, In your answer to question 324, for finding the gain from the use of a feed water heater, you say 140÷1118=12.5, the gain derived, etc. I do not quite understand this? *A.*—We said 140÷1118=12.5 *per cent.* In other words it equals $\frac{12.5}{100}$; 140 is 12.5 per cent. of 1118. 2, We have pair of engines 30″x60″, running 45 revolutions, steam pressure 70 lbs., cut off at half stroke. We wish to put in an independent jet condenser. The water will have to be raised 8 feet and carried horizontally 900 feet. Will a good pump draw it that distance? *A.*—Yes. 3, How many gallons of water per horse power per hour will be required? *A.*—About 75. 4, What will be the saving in fuel by the use of a condenser? *A.*—It should be from 15 to 25 per cent. 5, What should be the size of air pump and condenser? *A.*—In using independent condensing apparatus the dimensions cannot be well calculated from the dimensions of cylinder of engine, since the speed at which the pump is run will vary. Parties furnishing such apparatus will fix dimensions. 6, What should be the diameter of injection pipe? *A.*—For that length of pipe we should say it should be 10⅛″ diameter. 7, Will it pay to put in the condensing apparatus? *A.*—This you can calculate yourself by getting or making an estimate of the cost, and then figuring for a saving of, say, 20 per cent. in fuel.

(427) W. A. H., Graniteville, Mass., writes: 1. We have two gauges, one in engine-room and one in boiler-room, both being correct. The one in engine-room, about 75 feet away from boiler, indicates two pounds less pressure than the other. What is the cause? *A.*—If the gauge in engine-room is on main steam pipe, it will naturally indicate less pressure than the one on boiler, when the engine is running. If a separate pipe from boiler is used, there is some other reason. Perhaps it is in the location of the gauges, or perhaps if you were to test the gauges accurately you would find they did not agree exactly. Change places with the gauges, and note their indications. 2. How shall I take out my water-line glass and get it back again, without breaking it? *A.*—By screwing off the packing nuts the packing can be removed, then by raising the glass it will come out of the fitting at the lower end. Be careful not to scratch the glass or mark it with anything metallic, or it will be likely to break when hot. 3. What is the difference between bronze and brass castings? *A.*—The distinction is not, in practice, very clearly made. Brass may be described as an alloy of copper and zinc; bronze as an alloy of copper and tin, though the copper may have other metals mixed with it. 4. What is a good brass composition? *A.*—It depends upon the purpose for which it is to be used. Brass is made by the addition of ⅛ ounce to 10 ounces, or more, of zinc to 1 pound of copper.

(428) High Speed, Chicago, Ill., asks: What is the relation of force to velocity, and what distinction, if any, do you make between force to overcome resistance and force to overcome inertia? It takes four times the force to increase the speed of a train of cars from thirty to sixty miles an hour, more than four times the force to double the speed of a boat, yet I read that in a given time a given force will produce a double velocity in a given body, etc. What I would like to know is, what is the ratio of the increase of force in developing velocity, taking a fly-wheel as an example, starting from a state of rest, or the amount of force required to add the same amount to the velocity already acquired? *A.*—You can consider the fly-wheel as a body acted upon by gravity, and offering no resistance to motion, except that of inertia. Then the laws that apply to falling bodies will apply to it, and one-half the force of gravity will move it half the distance and impart to it one-half the velocity, or twice the force will move it twice the distance and impart twice the velocity in a given time that would be imparted by gravity. Double the force acting through double the distance does four times the work, and one-half the force through one-half the distance does one-quarter the work. If it requires a given force to attain a certain final speed in a given number of revolutions, it will take four times that force to obtain double the speed in the same number of revolutions, etc. Having attained the velocity due to the force and the time of its application, if the force is removed the wheel would continue to move at a uniform velocity; to double its velocity, keep the same force acting as much longer as it has already acted. The resistance which the body meets, whether a boat in the water, a train of cars, or a fly-wheel will vary approximately as the square of the velocity, since if the speed is doubled twice as much of the fluid must be displaced at twice the velocity. Besides these, the consideration of friction comes in, the effect of which can in any given instance be determined only by elaborate experiment. Also you can only experimentally determine what the resistance of the air at a given velocity will be.

BUSINESS SPECIALS

Transient Advertisements, 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Curtis pressure regulator and st'm trap. Oct. 25, p.13.

Mackenzie Cupolas and Blowers. 245 Broadway, N.Y.

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

Steel Name Stamps, &c J. B. Roney, Lynn, Mass

Rotary Files, Tower M. Works, E. Brookfield, Mass.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John street, N. Y.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 632 F st., Washington, D. C.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

Universal grinders for lathe-centers, chucks, angles, or cylinders. C. C. Hill, 84 Market st., Chicago, Ill

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

National and box chucks, foot and power lathes, and slide rests. Lodge, Barker & Co., Cincinnati, O.

Split Pulleys at low prices, and of same strength and Appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Mech'l drawing and machine designing, work requiring skill and experience solicited. Reasonable rates. Corresp'nce invited. Weston & Smith, Syracuse, N.Y.

DRAWINGS — Mechanical, electrical and Patent Office. All styles of artistic designing. Special facilities. Low rates. Wallace Metcalf, 140 Nassau St., N.Y.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

The "Wax Process" Engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large: prices low. Frasse & Co., 62 Chatham St., N. Y.

Farley's Reference Directory of the Machinists, Iron, Steel, and Metal-Working trades of the United States. A. C. Farley & Co., Philadelphia, Pa.

Improved Tack Machinery, made by The Willets Man'f'g Co., can be seen in operation at their works, 57 Clifford St., Providence, R. I.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

EXTRACTS FROM CHORDAL'S LETTERS, 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with over 50 illustrations. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

MANUFACTURES

Cozart & Hunley, Oxford, N. C., will build machine shops.

A cotton compress will probably be erected in Anniston, Ala.

M. E. Ezzell will open a carriage and wagon shop at Anniston, Ala.

Swerney & Skeen have completed their machine shops at Colorado, Texas.

Gravely & Co., Martinsville, Va., have built a foundry and machine shop.

Phillips, Marshall & Co. intend to build a $600,000 cotton mill at Yazoo City, Miss.

The Baltimore and Ohio Railroad will build a new round-house and machine shop at Wheeling, W. Va.

Abbott Haas, and others, Atlanta, Ga., have established a factory for making looms, spindles, etc.

Annie Derleth will erect a four-story factory to cost $10,000, on Lincoln avenue, near Boulevard, New York.

Kemp & Garrison, Philadelphia, are contractors for the building of a foundry 28x80 feet, at 228 N. 15th street.

The Southern Car Works, Knoxville, Tenn., are building an addition to their works, and will put in some new tools.

The Phœnix Chemical Company will build a factory 74x40 feet, on Second avenue, near 39th street, Brooklyn, N. Y.

The Furman Farm Improvement Company, of Atlanta, Ga., are spending about $60,000 in enlarging their works.

P. H. McManus will erect a five-story brick factory, 25x82 feet, at Avenue A and 75th street, New York. It will cost $16,000.

Ten manufacturers of steel rails, in the United States, have signed an agreement to work only upon half time during the first six months of 1885.

The extensive brass works at Lorain, O., operated by the United Brass Company, whose offices are in Cleveland, closed down the 29th ult. for sixty days.

The temporary machine shops at Meridian, Miss., of the Queen and Crescent system of railroads, were burned October 2. The loss is estimated at $100,000.

O. M. Beatty, of Concord, N. C., promises to build a $100,000 industrial school at Charlotte, N. C., and has purchased the ground for it.—*Baltimore Manufacturers' Record.*

Fernando B. Smith, proprietor of the Patent Novelty Works, Canton, O., is putting up an additional three-story shop. He intends to add stamping, cutting, and punching presses.

Nearly all the iron mills of Pittsburgh are going into specialties. They find that plan more profitable than to confine their whole production to the ordinary sizes and shapes of merchant iron.

Pedrick & Ayer, Philadelphia, manufacturers of special tools for railroad repair shops, closed their fiscal year October 1, and say the past year has been a very satisfactory one for their business.

The citizens of Connellsville, Pa., are raising the $25,000 needed to secure the erection of the B. & O. Railroad shops there. One man has subscribed $5,000, and the whole amount will be secured.

George H. Sanborn & Sons, 69 Beekman street, New York, have issued a new illustrated catalogue of embossing presses. They are made by the Standard Machinery Company, Mystic River, Conn.

The demand for laborers and mechanics at the Castle Garden Labor Bureau is poor at present. Mechanics fix their wages at the current rates of their particular trade, and day laborers get $1.25 a day.

The Exeter (N. H.) Machine Works are building a 12-inch tapping machine to go to Pennsylvania. It is the largest machine of its kind in this country, with the exception of one, which was imported from England.

The Belcher & Taylor Agricultural Tool Company, Chicopee Falls, Mass., have a new illustrated catalogue of implements made by them, consisting of plows, cultivators, steam cutters, haying tools, etc. All the tools are fully described.

The Prindle Manufacturing Company, of Aurora, Ill., with a capital stock of $12,000, have just been incorporated. They will manufacture door hangers, window fasteners, carpet sweepers, etc., and will begin operations January 1.

The Harrison Boiler Works, Germantown Junction, Philadelphia, are doing a flourishing business, reporting trade very fair. Their principal specialty is the Harrison safety boiler, though they also manufacture the Creasey ice breakers.

J. S. Holden & Co., woolen manufacturers, Palmer, Mass., are running their mill nights, in order to keep up with the demand for their goods. This firm, one year ago, adopted the plan of selling their own goods, and have met with success from the first.

The Kensington Engine Works, of Philadelphia, have recently built an important addition to their works, besides making many improvements in their plant. They say their engine business grows steadily. They employ forty-two men, outside of pattern and forging shops.

Stedman & Banes, founders and machinists, Helena, Montana, have nearly finished their new premises, a substantial stone building 40x90 feet, for foundry and machine shop. They will put in a 20-horse power engine, 56 inch cupola, No. 8 Sturtevant blower, and one more lathe.

The Springfield (Mass.) Steam Power Company will immediately put up an immense four-story building, 150x50 feet, with two wings, each 110x40 feet, at Dwight and Taylor streets. The cost will be over $40,000, and will be finished by May 1, for the National Papeterie Company.

T. C. Massey, manufacturer of Massey's E. & R. patent vises, has moved his manufactory from Batavia to Chicago, 11 to 23 South Jefferson street. The vises, we hear, are becoming a very popular tool amongst manufacturers, being of simple construction and easily operated.

The number of foundries, boiler, and iron works, in San Francisco is seventeen, and which employ 2,400 men. The value of manufactures is about $5,000,000 annually. They consume annually 24,200 tons of pig iron, 25,600 tons of bar iron, and 480 tons of rivets. Of the pig iron used, fully one-half is produced on the Pacific coast.

The partners in the new steel nail works to be erected in Pottstown, Pa., have applied for a charter, under the name, style, and title of the Ellis & Lessig Steel and Iron Company, limited. The names of the partners in the concern given in the application are William S. Ellis, George B. Lessig, J. B. Lessig, jr., and Thomas Searles.

George C. Howard, Philadelphia, Pa., is applying a new safety device to elevators of his manufacture. In this arrangement should the speed of the elevator be unduly increased, the operation of a shoe and clutch is such as to lift the latter into contact with a guide, stopping the car. The device can be set so as to be operative at any desired speed.

Samuel S. Dittenhoefer, formerly a member of the Viaduct Foundry Company, Mr. Brown, the former book-keeper for that concern, and Mr. Lansdown, their former foreman, have associated themselves under the firm name Standard Foundry Company, and will carry on the manufacture of light gray iron castings.—*Cleveland Iron Trade Review.*

Dr. Chilton Ogden, who succeeded the firm of E Robertson & Co., of Joliet, Ill., manufacturers of brass and iron castings, is enlarging these works and will double their capacity. The addition which is now being built is 24x36 feet in size and two stories high. A machine shop has also been added. The works are expected to be in operation in ten days. —*Industrial World.*

A. F. Cushman, Hartford, Conn., has issued a neat pocket catalogue of chucks and tools manufactured by him. It is fully illustrated, and gives prices of all sizes and styles of chucks. Several new styles have been added since the previous catalogue was issued. In the preface, he says: "My facilities are extensive, and I carry the largest assortment and stock of chucks in the world."

The question as to whether the Northeastern Railroad shops, at Meridian, Miss., says the New Orleans *Picayune*, are to be rebuilt or not is as yet undecided. The matter is now before the general officers of the Queen and Crescent line at Cincinnati, and efforts are being made to cause their removal to Chattanooga. That city advances the claim of superior facilities and convenience.

The Phœnix Iron Works, Meadville, Pa., write us: Our business this year has compared favorably with last year. We have had a great deal of boiler work, obliging us to run overtime, and engine orders are on the increase. We have taken the contract for eight (8) engines for the Von Schmidt Dredges, at Washington, aggregating 700-horse power, together with the boilers, discharge pipes, etc. Our new pattern of engine is taking immensely, and the outlook for next year is decidedly encouraging.

Warden & Mitchell is the name of a new firm which has recently built extensive works at Germantown Junction, Philadelphia, for the manufacture of steam boilers, gas holders, tanks, stills, and other wrought-iron work. Both members of the firm were formerly connected with the mechanical department of the Standard Oil Company. They are just finishing a contract to build a "cable tube," several miles long, for use on Market street, Philadelphia. They are equipped with hydraulic riveting plant, and full facilities. The main shop is 52x207 feet, with wing 30x108 feet, besides blacksmith shop 30x60 feet.

The stockholders of the New York City gas companies embraced in the consolidation scheme have been notified that a vote upon ratifying it will be taken November 5. The capital of the consolidated company is to be $45,000,000, of which $1,500,000 will be disposed of for the purchase of materials and supplies, and the remaining $43,500,000 allotted to the present companies, as follows: New York, $7,500,000; Manhattan, $11,940,000; Metropolitan, $7,175,000; Municipal (including the Knickerbocker), $8,100,000; Harlem, $3,000,000. They had a bill passed by the legislature last winter forbidding any other company to tear up the streets. This gives them a full monopoly.

In the way of large tools, William B. Bement & Son, of Philadelphia, are just now building a punching and shearing machine for the Keystone Bridge Company, which will punch a 4 inch hole in 1½ inch iron, 3 feet from the edge. Frame of machine weighs 23 tons, the eccentric shaft being 13 inches diameter. Shearing blades of different shapes, and punches of different sizes can be used. Frame of machine is 10 feet in height. The machine will make 16 cuts per minute. This firm are also building a punching machine for the Miltimore Car-Wheel Company, to punch the arm of their car wheel out of flat bars of steel 1 inch thick. This machine will punch a 5-inch hole in 1-inch iron. The frame weighs 15 tons. Patterns are now also being made in the Bement shops for a lathe which will be capable of turning a shaft 53 feet long. The lathe is 70 feet in length, swings 60 inches, will be double-headed and triple-geared. Weight about 50 tons.

Machinists' Supplies and Iron.

NEW YORK, October 16, 1884.

The past week has shown no new developments in the supply business. Trade remains quiet, with no evidence of immediate change. Dealers take a hopeful view, but are inclined to base their calculations on a slow rather than an immediately rapid improvement. Transactions are for immediate wants, and with no stock in the hands of users are a fair gauge by which to measure business in the lines represented by sales. Times are hard for the introduction of novelties, buyers holding close to standard articles.

The machine business remains in substantially the same condition that it has been in for the past three months. In some lines there is a little more activity, but as a whole there is not much that can fairly be called improvement. The usual fall industrial exhibitions are in operation, and may be expected to influence some business.

There is no change in American iron since last quotations. There is hardly sufficient demand to keep even with production. In some brands there is no accumulation, but in others a slight overproduction is apparent. Altogether the feeling is not a hopeful one, though some are inclined to believe that next month will show an improvement. We quote best brands of Lehigh No 1 X Foundry steady at $19.50 to $20, with inferior brands from 50c to $1 lower No. 2 X Foundry has sold at $18 to $19, with supply in excess of the wants of purchasers. Grey Forge $15.50 to $16.50.

In Scotch pig the demand for immediate use has been comparatively fair. Sales of Shotts $21.50 to $21.75, to arrive; Coltness $22.50, at yard; Glengarnock $21 50, at yard; Gartsherrie $21.50 to $22; Summerlee $21; Eglington $19.50.

Antimony is quoted at: Hallett's 10c. Cookson's 10¾c., but purchases are made at slightly lower figures.

Copper is in light demand, and with more sellers than buyers prices favor the latter. Lake has sold in small lots at 12⅝c and Baltimore at 11⅞c.

Lead is held at 3.75c., holders taking some lots at 3,70c.

Spelter—Refined 8c. to 8¾c.

Tin feels the demoralization of the English market, and prices are hardly steady. Jobbing lots of Banca have sold at 19¾c.; Straits and Malacca at 19⅝c.

✻WANTED✻

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Good machine pattern maker wants a situation. Address "Pattern Maker," Box 379, S. Norwalk, Ct.

Wanted--Situation as foreman brass moulder. Well up in locomotive and general work. Go anywhere—Englishman. Address R. E., 746 De Kalb avenue, Brooklyn, N. Y.

Wanted—Situation by young man of considerable experience in wood work. Prefers pattern making. Best of references. Address J. M. Richardson, 25 Patton street, Springfield, Mass.

First-class mechanical engineer and draughtsman, with extensive experience as designer, superintendent, and salesman, is open to an engagement. Steam engineering a specialty. Best of references. Address "M. 103," AM. MACHINIST.

For Sale—Richards-Elliott Indicator, in excellent condition, with five springs, scales, and details complete. Price $40. Address "Mechanical Engineer," 71 E. Eighth street, Covington, Ky.

$5,000 will buy a well-established machine shop, in the best locality in the city, with valuable patents and steady work all the year round; will bear inspection. Address "Scio," AM. MACHINIST, N. Y.

Parties having unequaled facilities for both foundry and machine work, and having the best of tools, suitable for either light or heavy work, wish to take contracts to manufacture anything in the shape of machinery or patent specialties in metal. Address "Specialties," care AM. MACHINIST.

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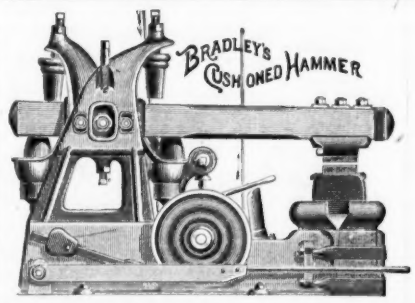
800 N. SECOND ST., ST. LOUIS, MO.
MACHINERY FOR SALE.
SECOND-HAND.
One Putnam Screw-Cutting Engine Lathe,
42 Inch Swing, 26 feet bed, all complete, in fine condition.
Catalogues of New Machinery on Aprlication.



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For Reducing and Pointing Wire.
Especially adapted to pointing wire rods and wire for drawing.
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The Waters Perfect Governor.
Having Adjustable Speed, Automatic Safety Stop, Sawyer's Lever, and Solid Composition Valves and Seats. Also
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Please send for circular and state that you saw the advertisement in this paper.

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at 2½ cents per pound, to close out stock on hand.
Send for printed list of dimensions.
THE JOHN T. NOYE MFG. CO., Buffalo, N. Y.

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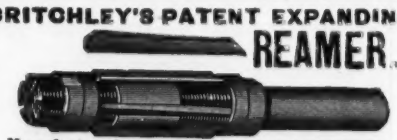

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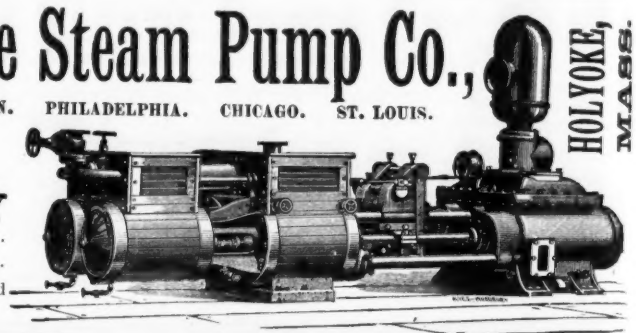

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STANDARD TOOL CO., Cleveland, Ohio. W. A. BABCOCK, Manager.

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Office THE DOMESTIC MFG. CO.,
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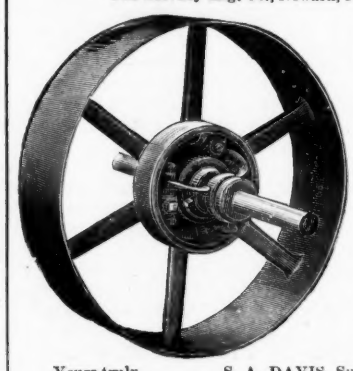
Mr. JOHN C. BLEVNEY, Pres.,
The Blevney Mfg. Co., Newark, N. J.



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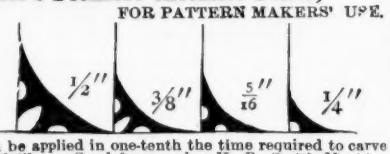

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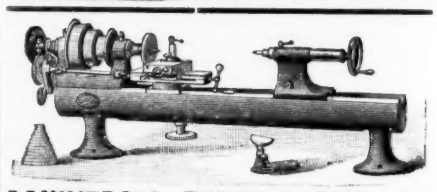

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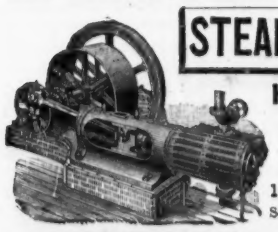

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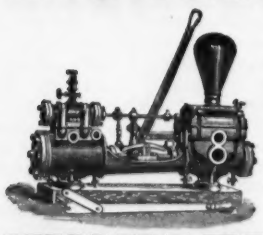

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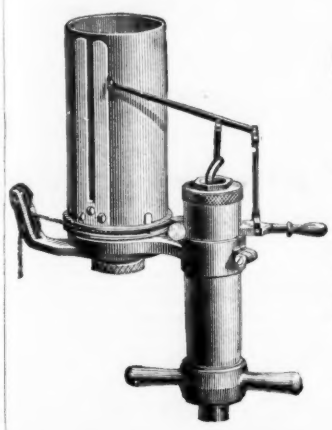

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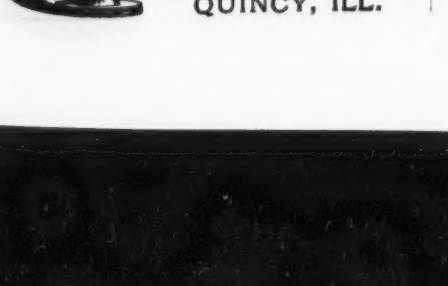

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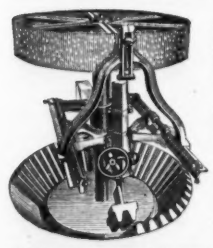

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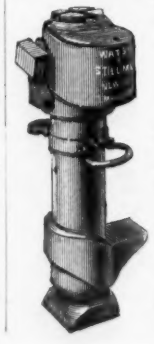

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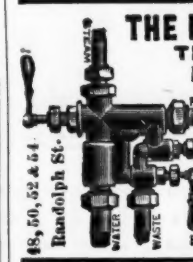

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" 14	2 1-2 "	1.60
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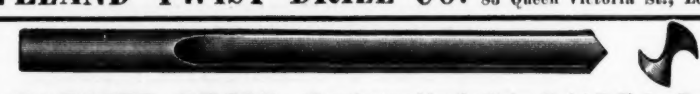

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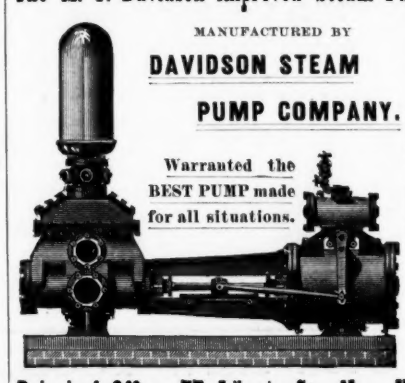

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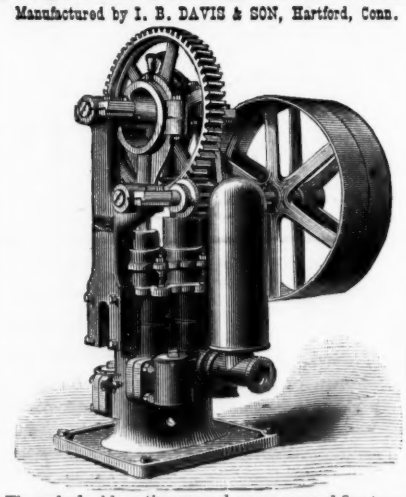

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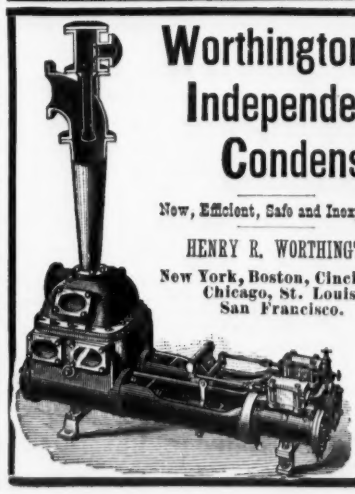

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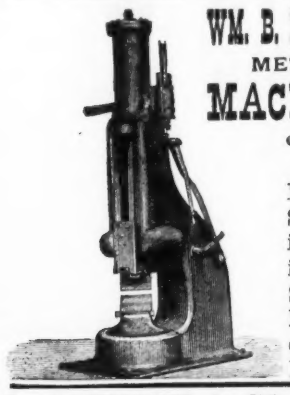

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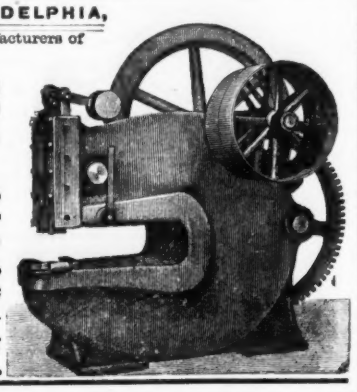

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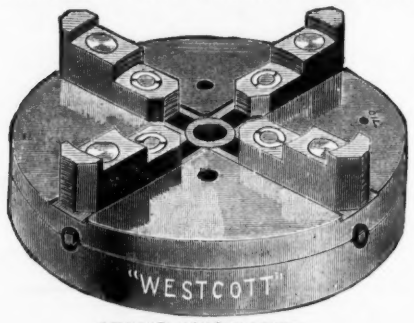

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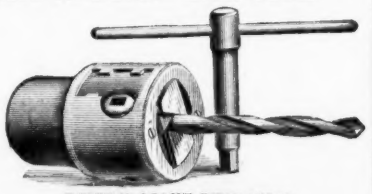

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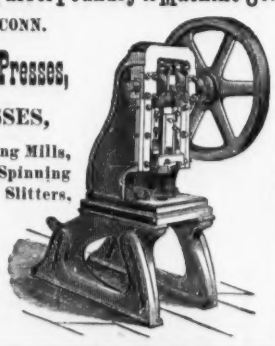

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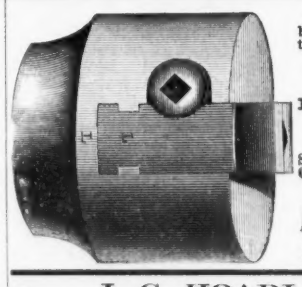

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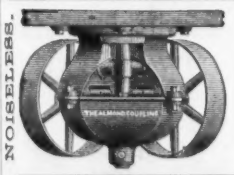

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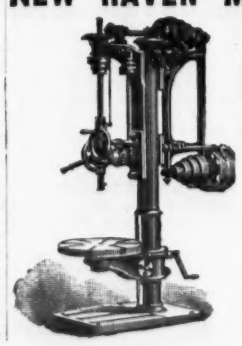

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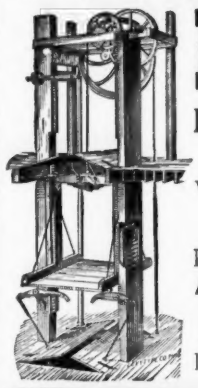

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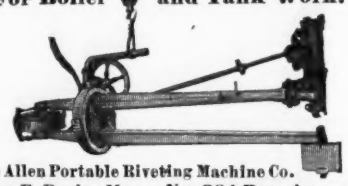

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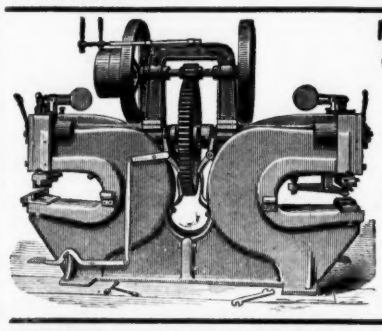

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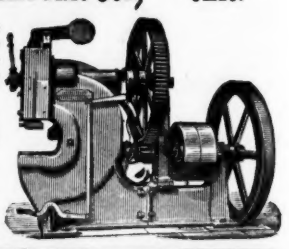

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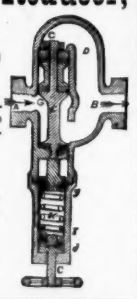

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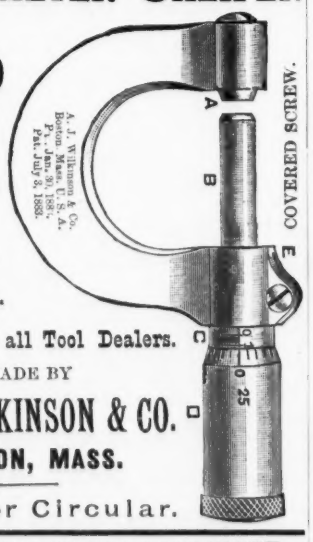

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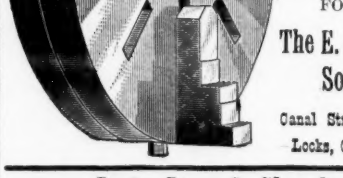

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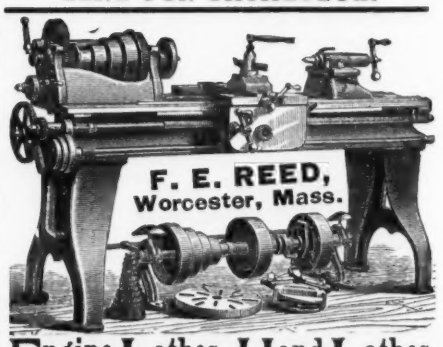

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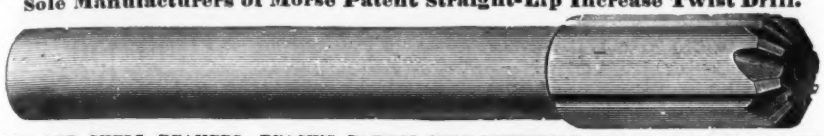

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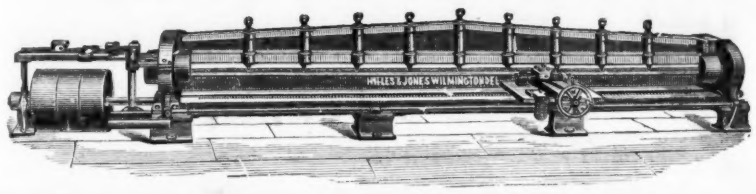

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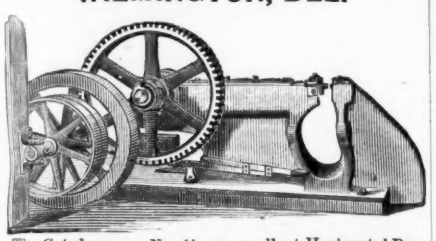

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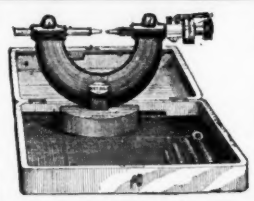

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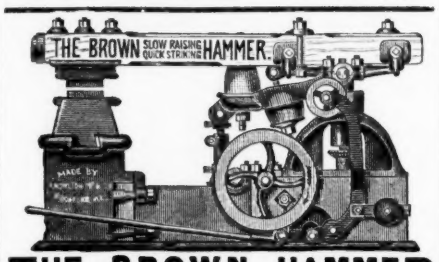

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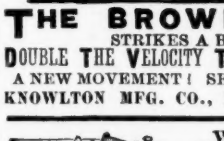

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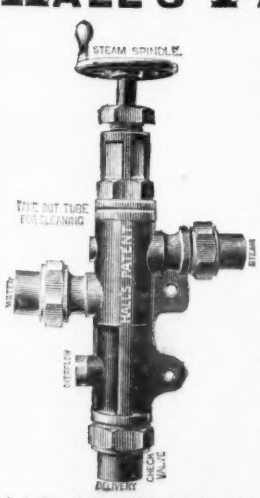

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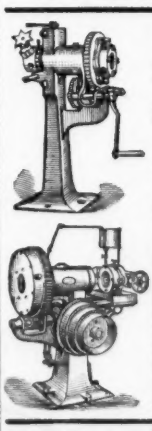

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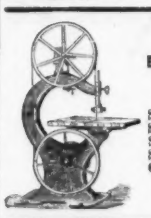

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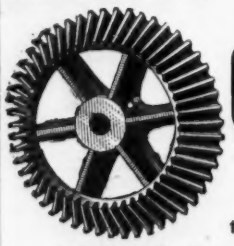

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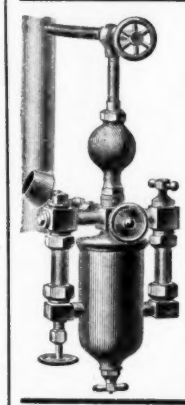

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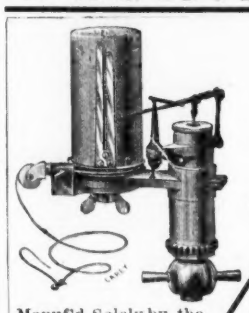

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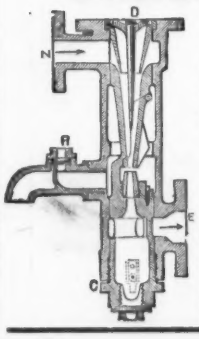

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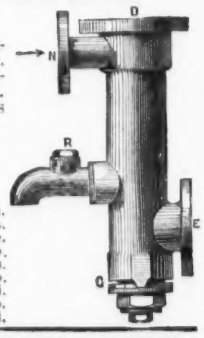

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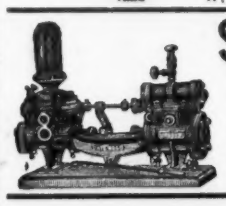

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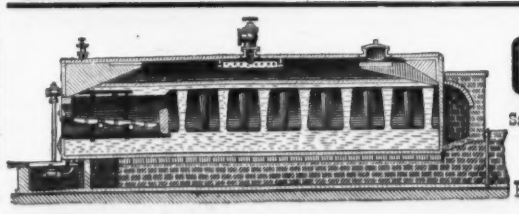

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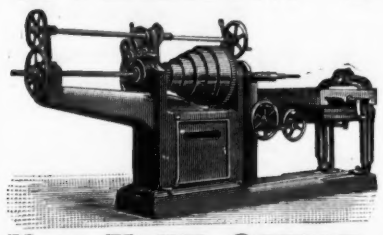

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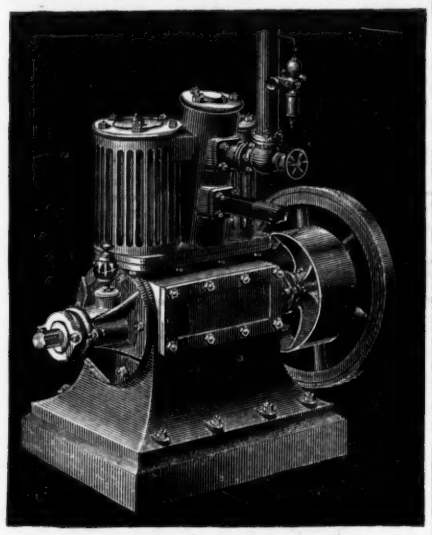

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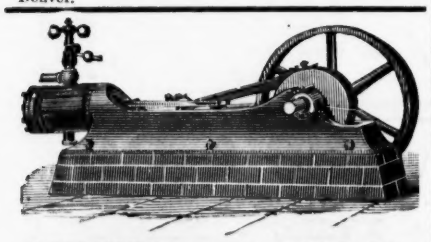

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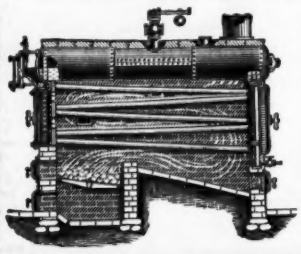

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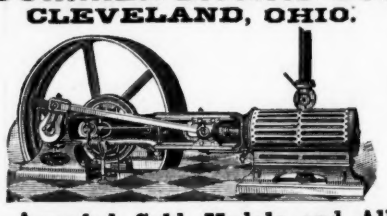

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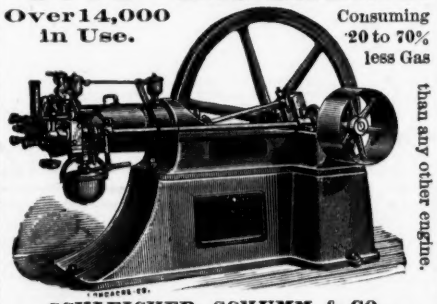

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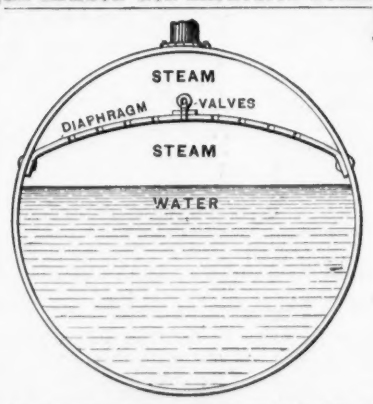

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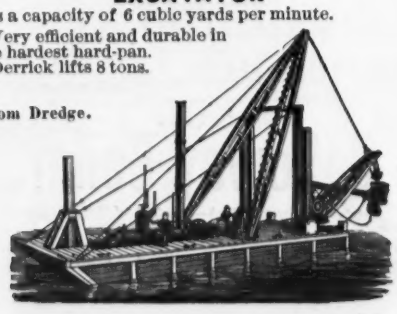

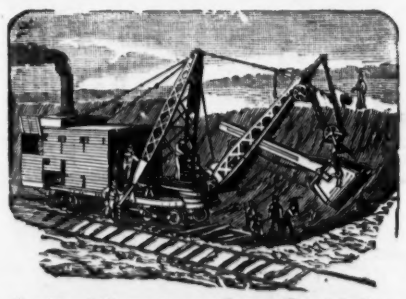

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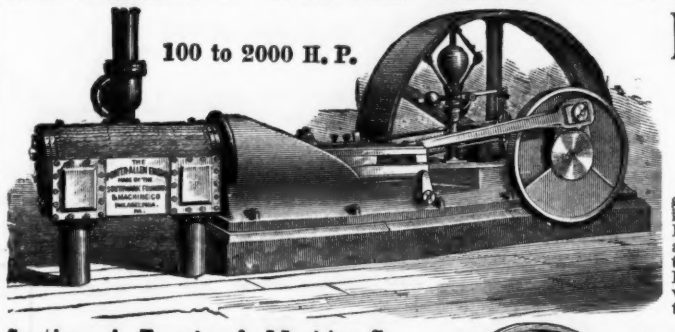

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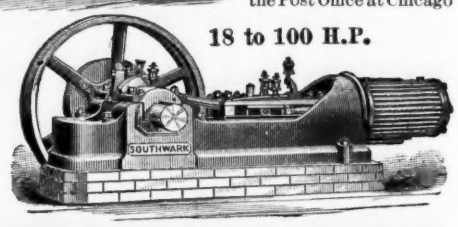

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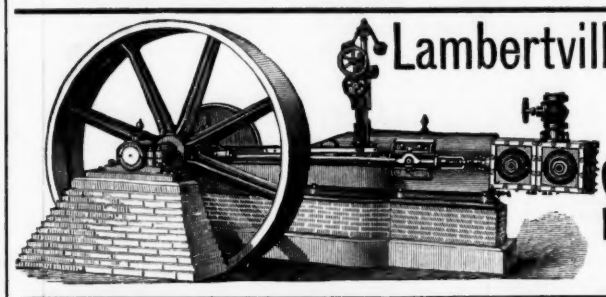

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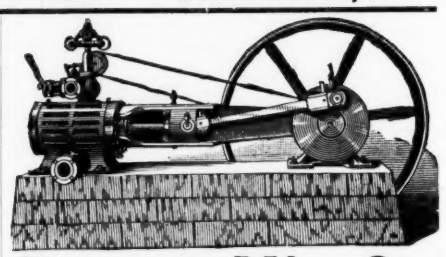

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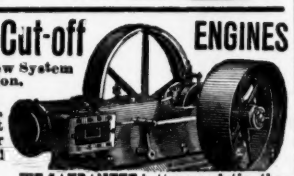

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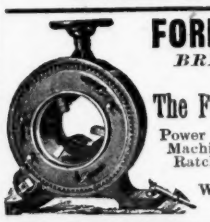

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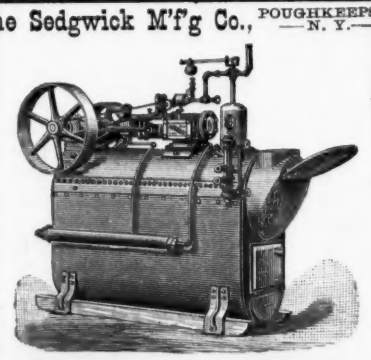

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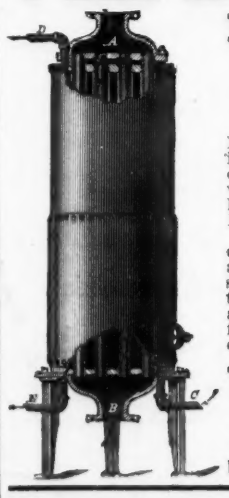

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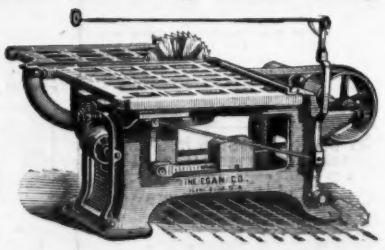

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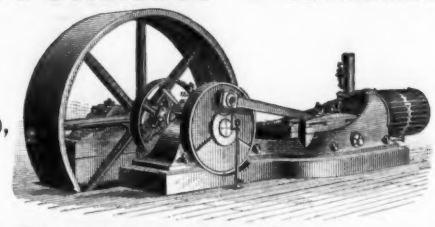

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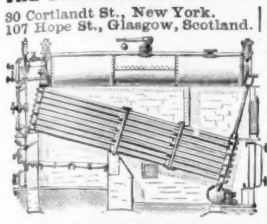

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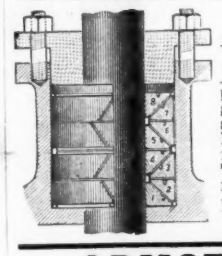

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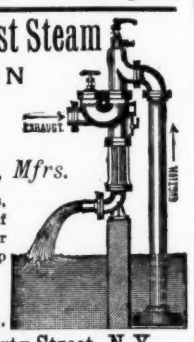

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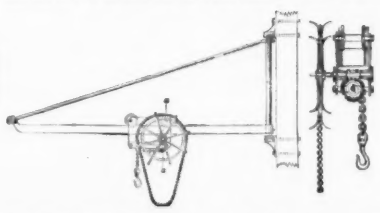

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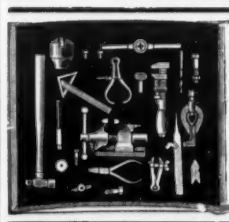

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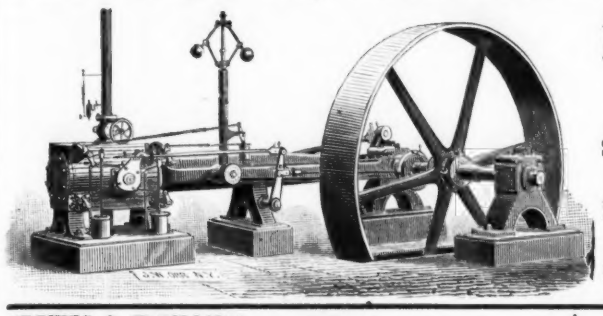

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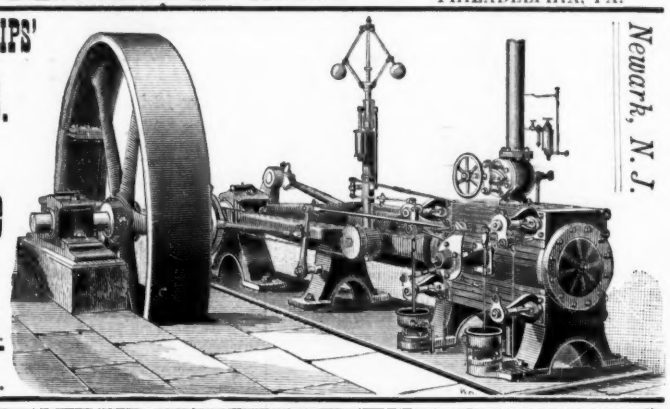

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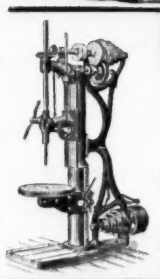

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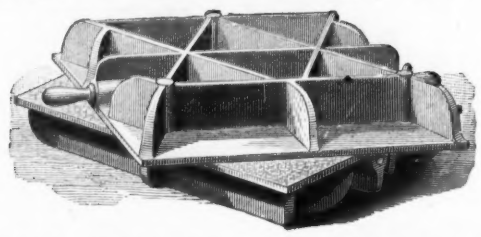

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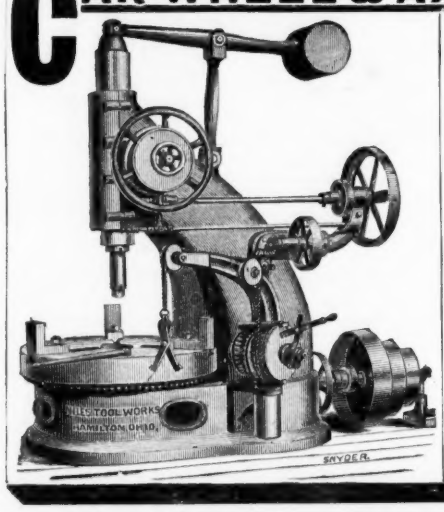

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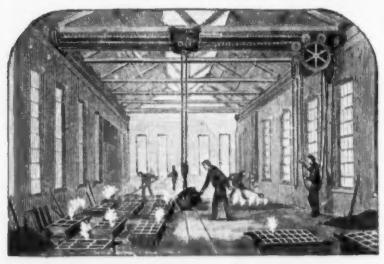

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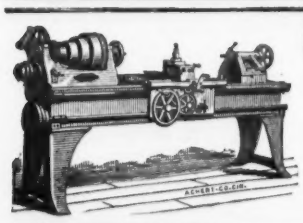

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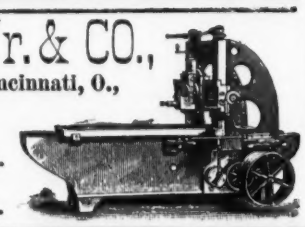

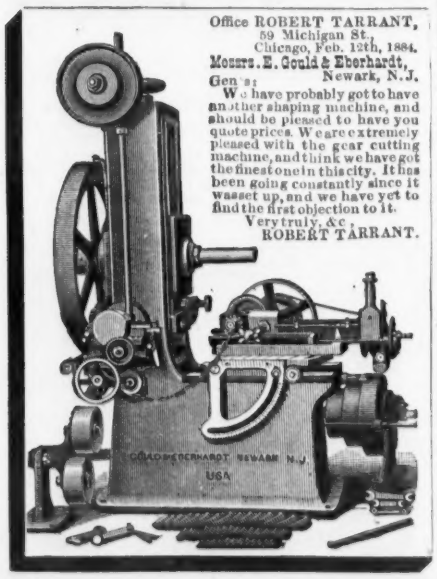

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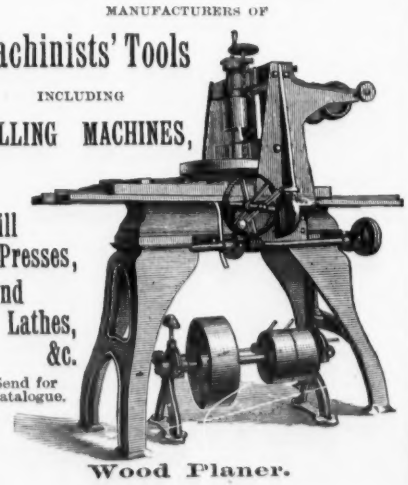

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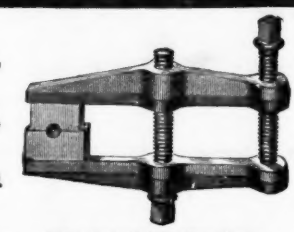

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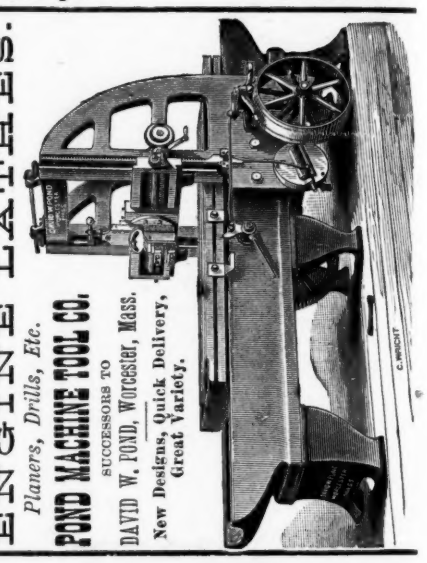

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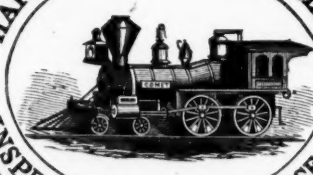

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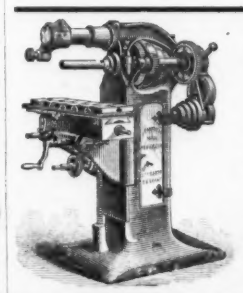

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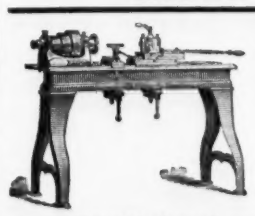

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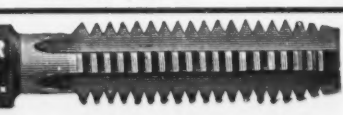

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